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AN INGENIOUS ELECTRIC MOTOR.

An Application of Electricity Which is Likely to Prove Valuable in the Workshop.

COMMERCIAL SUCCESSES VS. SCIENTIFIC SUCCESSES — MESSRS. AYRTON AND PERRY APPLY ELECTRICITY TO DRIVING DRILLS, EMERY WHEELS, CIRCULAR SAWS, FANS, CENTRIFUGAL PUMPS, ETC.—THE VARIOUS MEANS THEY HAVE DISCOVERED FOR PREVENTING A LOSS OF POWER WHILE THEIR MOTOR IS NOT DOING EFFECTIVE WORK.

Amid the cloud of impracticable projects that hangs continually over the electrical field, it is with a feeling of satisfaction that we discern here and there something of real value, something destined to perform a real service in a practical sphere The public has become wearied with iteration and reiteration of what this or the other electrical contrivance is to do in the future, without the slightest practical demonstration accompanying the assertions, by way of corroboration.

For this reason, the ELECTRICAL REVIEW has sought to place more prominently before its readers those discoveries in the application of electricity which have been shown to have a value outside of the laboratory and the lecture-room.

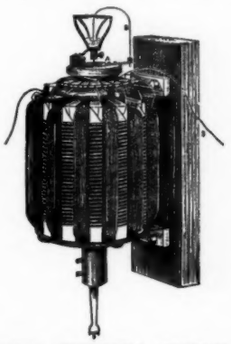
Following this course, we herewith present to our readers a faithful illustration of an ingenious electrical motor, which possesses many elements and attributes of mechanical usefulness.

Up to the present time, whenever it has been necessary to convert electrical energy into mechanical energy, use has been made of a dynamo worked backwards. But a dynamo is designed for converting mechanical energy into electrical energy, and not to do the converse; therefore, although every dynamo will act as a motor, Professors Ayrton and Perry have concluded that, for its weight, it is by no means the most powerful motor that can be designed.

In a dynamo there is a large electro-magnet, which produces what is termed the exciting field, and a moving armature, the current flowing through which produces another magnetic field, which in all dynamos tends to weaken the first and important magnetic field. Hence the best dynamos have been so designed that, while the exciting electro-magnets produce a very strong field, the armature shall produce a very weak field.

The result has been arrived at partly by making the armature of a dynamo small compared with the exciting electro-magnets, and partly by giving it a squat form; but, in a motor, these gentlemen concluded from certain theoretical and practical considerations that, on the contrary, the strengths of the two magnetic fields produced by the exciting magnets and by the armature should be equal; and since the armature, from its shape, is necessarily rather a weak magnet, whereas the field or exciting magnet, from its shape, is a strong one, they have reversed the usual condition of things and made the armature large and the field magnet small, and from this have been led to make the armature stationary and surrounding the field magnet, instead of, as usual, the field magnet surrounding the armature.

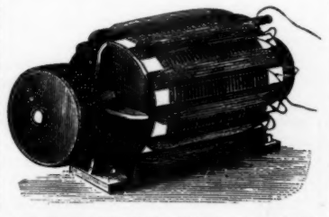
The field magnet they have constructed carries the brushes and revolves inside the stationary armature, the coils of which are joined to the stationary commutator, which, unlike ordinary commutators, is made flat, to save both space and expense, and in this way they have, they believe, obtained, *weight for weight*, a much more powerful motor than can be obtained by using a dynamo as well as a more efficient motor for its size—that is,



MOTOR, WITH DRILL ATTACHED

the ratio of electric power put into mechanical power given out is greater than in the case of a dynamo of the same size used as a motor.

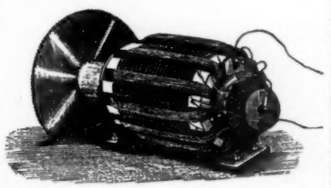
The words "for its size" are used advisedly, because not only does the horse power of a motor increase far more rapidly than its weight when the same current is flowing through it, but so also does the efficiency. The increase of power is between the fourth



MOTOR, WITH EMERY WHEEL ATTACHED.

and fifth power of the linear dimensions of the motor while the weight and cost only increase with the cube. For example, one of these motors—many of them have recently been publicly exhibited in England—weighing under forty pounds, will produce effectively half a horse power, while one twice as long and of twice the diameter, weighing therefore 320 pounds, or eight times as much, will produce from eight to ten horse power, that is, from sixteen to twenty times as much. Very small motors producing, say one-twentieth of a horse-power, can have only quite a small efficiency, and are, in fact, not economic converters of power, while motors producing several horse-power experiment has shown may, when properly constructed, have an efficiency of from 70 to 80 per cent.

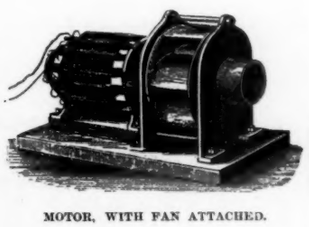
Why then, it may be asked, should small motors be used at all if larger ones are so much more efficient? Because the total waste of power when any motor is used to drive machinery does not only occur in the motor itself, but also in the shafting employed to transmit the power to the machine, and in the belting, toothed wheels or other gearing employed at the machine itself to produce a high speed, if it be a fast speed machine. Consequently, for quick moving, small tools like drills, emery wheels, small circular saws, small electro-motors are of great value, since not only does the entire absence of all intermediate gearing but the



MOTOR, WITH CIRCULAR SAW ATTACHED.

enormous convenience of being able to bring machine driven tools to any part of the work instead of having to bring the work to the tool far more than compensates for the efficiency of small electro-motors being less than that of larger ones, and for large, quick-moving machines like fans, centrifugal pumps, screws of small launches, &c., large electro-motors will be invaluable, since they will combine high efficiency with absence of all shafting and the power of shifting the position of the motor and machine at will in the workshops.

In the rough experiments it was found that the motor increased in speed when the work was removed. Were this unavoidable it would be a serious drawback to the general adoption



MOTOR, WITH FAN ATTACHED.

of electro-motors for commercial purposes. It would never do for a piece of wood or iron in a lathe to rush round when the chisel was taken off, since not only would there be a great waste of power, but on next applying the chisel it would be probably broken by the wood or iron while rotating with such an excessive velocity, nor would it do for the screw of an electric launch to race when the boat pitched.

Fortunately, Professors Ayrton and Perry have found a means of preventing this; of arranging that the supply of electric energy shall be in proportion to the demand, and also that their motors consume this energy in proportion to the work they have to do—in other words, the electro-motor must be governed so as always to run at the same speed, whatever the work it may be doing.

In order to accomplish this, Messrs. Ayrton and Perry have designed what they call a "periodic" governor.

If the motors are in series, they arrange that the periodic governor shunts the current periodically, instead of introducing resistance. In some of their motors with flat commutators, the periodic governor is constructed as part of the commutator itself, to avoid the necessity of employing any separate apparatus. With the periodic governor the power is never entirely cut off for any length of time, nor, on the other hand, is full power ever put on for any length of time; but in every revolution power is supplied during a portion of the revolution, the proportion of time in every revolution during which much power is supplied to the time during which less is supplied depending on the amount of work the motor is doing.

But still another and more effective mode has been found of preventing the waste of power, and that is by using a brake. When the useful work being done is small the brake power would be large, and when the useful work is large the brake-power would be small, the sum of the two being kept constant.

A system like this would, of course, be practical but not economical if the brake attached to the motor were to use up the surplus power in producing heat, but this brake stores up the surplus power in such a form that it can be utilized later on in working the motor. Such an arrangement has been effected by combining a dynamo with the motor in a variety of different ways. The motor converts electric energy into mechanical energy, while the dynamo reconverts some of this mechanical energy into electric energy, which is added to that supplied by the mains; and by arranging the resistance in the dynamo circuit so that the desired speed of the motor corresponds with the critical speed of the dynamo, the brake-power exerted by the dynamo becomes extremely large if the speed of the motor even slightly exceeds the prearranged speed.

By this ingenious method Messrs. Ayrton and Perry have reduced the loss of power caused by "racing," so to speak, to a minimum.

Some Points in Electric Lighting.

BY DR. JOHN HOPKINSON, F. R. S.

The science of lighting by electricity divided into two principal parts—the methods of production of electric currents, and of conversion of the energy of those currents into heat at such a temperature as to be given off in radiations to which the eye was sensible. The laws known to connect together those phenomena, called electrical, were essentially mechanical in form, closely correlated with mechanical laws, and might be most aptly illustrated by mechanical analogues. For example, the terms "potential," "current" and "resistance" had close analogues respectively in "head," "rate of flow," and "co-efficient of friction" in the hydraulic transmission of power. Exactly as in hydraulics, head multiplied by velocity of flow was power measured in foot-pounds per second or in horse power, so potential multiplied by current was power, and was measurable in the same units. Again, just as water flowing

in a pipe had inertia and required an expenditure of work to set it in motion, and was capable of producing disruptive effects if that motion were too suddenly arrested, so a current of electricity in a wire had inertia; to set it moving electromotive force must work for a finite time, and if arrested suddenly by breaking the circuit the electricity forced its way across the interval as a spark. Corresponding to mass and moments of inertia in mechanics there existed in electricity coefficients of self-induction. There was, however, this difference between the inertia of water in a pipe and the inertia of an electric current—the inertia of the water was confined to the water, whereas the inertia of the electric current resided in the surrounding medium. Hence arose the phenomena of induction of currents upon currents, and of magnets upon moving conductors—phenomena which had no immediate analogues in hydraulics.

The laws of induction were then illustrated by means of a mechanical model devised by the late Professor Clerk Maxwell.

In the widest sense, the dynamo-electric machine might be defined as an apparatus for converting mechanical energy into the energy of an electro-static charge, or mechanical power into its equivalent electric current through a conductor. Under this definition would be included the electrophorus and all frictional machines; but the term was used in a more restricted sense, for those machines which produced electric currents by the motion of conductors in a magnetic field, or by the motion of a magnetic field in the neighborhood of a conductor. The laws on which the action of such machines was based had been the subject of a series of discoveries. Oersted discovered that an electric current in a conductor exerted force upon a magnet; Ampere that two conductors conveying currents generally exerted a mechanical force upon each other; Faraday discovered—what Helmholtz and Thomson subsequently proved to be the necessary consequence of the mechanical reactions between conductors conveying currents and magnets—namely, that if a closed conductor moved in a magnetic field, there would be a current induced in that conductor in one direction, if the number of lines of magnetic force passed through the conductor was increased by the movement, in the other direction if diminished. Now all dynamo-electric machines were based on Faraday's discovery. Not only so, but however elaborate it might be desired to make the analysis of the action of a dynamo machine, Faraday's way of presenting the phenomena of electro-magnetism to the mind was in general the best point of departure. The dynamo machine, then, essentially consisted of a conductor made to move in a magnetic field. This conductor, with the external circuit, formed a closed circuit in which electric currents were induced as the number of lines of magnetic force passing through the closed circuit varied. Since, then, if the current in a closed circuit was in one direction when the number of lines of force was increasing, and in the opposite direction when they were diminishing, it was clear that the current in each part of such circuit which passed through the magnetic field must be alternating in direction, unless, indeed, the circuit was such that it was continually cutting more and more lines of force, always in the same direction. Since the current in the wire of the machine was alternating, so, also, must be the current outside the machine, unless something in the nature of a commutator was employed to reverse the connections of the internal wires in which the current was induced, and of the external circuit. There were then, broadly, two classes of dynamo-electric machines; the simplest, the alternating-current machine, where no commutator was used; and the continuous-current machine, in which a commutator was used to change the connection with the external circuit just at the moment when the direction of the current would change. The theory of the alternate-current machine was then explained, and it was proved that two independently driven alternate-current machines could not be worked in series, but that they might be worked in parallel circuit, and hence were quite suitable for distribution of electricity for lighting without the necessity of providing a separate circuit for each machine.

It was easy to see that, by introducing a commutator revolving with the armature, in an alternate-current machine, and so arranged as to reverse the connection between the armature and the external circuit just at the time when the current would reverse, it was possible to obtain a current constant always in direction; but such a current would be far from constant in intensity, and would certainly not accomplish all the results obtained in modern continuous current machines. This irregularity might, however, be reduced to any extent by multiplying the wires of the armature, giving each its own connection to the outer circuit, and so placing them that the electromotive force attained a maximum successively in the several coils. A practically uniform electric current was first commercially produced with the ring armature of Pacinotti, as perfected by Gramme. A dynamo machine was not a perfect instrument for converting mechanical energy into the energy of electric current. Certain losses inevitably occurred. There was the loss due to friction of bearings, and of the collecting brushes upon the commutator; there was also the loss due to the production of electric currents in the iron of the machine. When these were accounted for, there remained the actual electrical effect of the machine in the conducting wire; but all of this was not available for external work. The current had to circulate through the armature, which inevitably had electrical resistance; electrical energy must, therefore, be converted into heat in the armature of the machine. Energy must also be expended in the wire of the electro-magnet which produced the field, as the resistance of this also could not be reduced beyond a certain limit. The loss by the resistance of the wires of the armature and of the magnets greatly depended on the dimensons of the machine. To know the properties of any machine thoroughly, it was not enough to know its efficiency and the amount of work it was capable of doing; it was necessary to know what it would do under all circumstances of varying resistance or varying electromotive force; and, under any given conditions, what would be the electromotive force of the armature? Now, this electromotive force depended on the intensity of the magnetic field, and the intensity of the magnetic field depended on the current passing round the electro-magnet and the current in the armature. The current then in the machine was the proper independent variable in terms of which to express the electromotive force. The simplest case was that of the series-dynamo, in which the current in the electro-magnet and the armature was the same, for then there was only one independent variable. The relation between electromotive force and current might be most conveniently expressed by a curve.

Where four years ago the lecturer first used such a curve (since named by Deprez the "characteristic curve") for the purpose of expressing the results of his experiments on the Siemens dynamo machine, he pointed out that it was capable of solving almost any problem relating to a particular machine, and that it was also capable of giving good indications of the results of changes in the winding of the magnets, or of the armatures of such machines. The use of the charac teristic curve was illustrated with reference to charging accumulators and Jacobi's law of electric transmission of power.

Where the dynamo machine was not a series-dynamo, but the current in the armature and in the electro-magnet, though possibly dependent upon each other, were not necessarily equal, the problem was not so simple. In that case there were two variables, the current in the electro-magnet and the current in the armature; and the proper representation of the properties of the machine would be by a characteristic surface, of which a model was exhibited. By the aid of such a surface any problem relating to a dynamo machine could be dealt with, no matter how its electro-magnets and its armature were connected together. Of course, in actual practice the model of the surface would not be used, but the projections of its sections.

The properties of a machine depended much upon its dimensions. Suppose two machines alike in every particular, excepting that the one had all its linear dimensions double that of the other. The electrical resistances in the larger machine would be one-half those of the smaller. The current required to produce a given intensity of magnetic field would be twice as great in the larger machine as in the smaller. The comparative characteristic curves of the two machines, when driven at the same speed, were shown in a diagram. The two curves were one the projection of the other, having corresponding points with abscisses in the ratio of one to two, and the ordinates in the ratio of one to four. At first sight it would seem that the work done by the larger machine should be thirty-two times as much as that which would be done by the smaller. Practically, however, no such result could possibly be attained for many reasons. First, the iron of the magnets became saturated, and consequently instead of eight times the electromotive force, there would only be four times the electromotive force. Secondly, the current which the armature could carry was limited by the rate at which the heat generated in the armature could escape. Again, the larger machine could not run at so great an angular velocity as the smaller one. And lastly, since in the larger machine the current in the armature was greater in proportion to the saturated magnetic field than in the smaller one, the displacement of the point of contact of the brushes with the commutator would be greater. Shortly, the capacity of similar dynamo machines was pretty nearly proportionate to their weight, that was, to the cube of their linear dimensions; the work wasted in producing the magnetic field was directly as the linear dimensions; and the work wasted in heating the wires of the armature was as the square of the linear dimensions.

A consideration of the properties of similar machines had another important practical use. Mr. Froude was able to control the design of iron-clad ships by experiments upon models made in paraffine wax. It was a much easier thing to predict what the performance of a large dynamo machine would be, from laboratory experiments made upon a model of a very small fraction of its dimension. As a proof of the practical utility of such methods, the lecturer stated that by laboratory experiments he had succeeded in greatly increasing the capacity of the Edison machines, without increasing their cost, and with a small increase of their percentage of efficiency, remarkably high as that efficiency already was.

The electric properties of the electric arc were experimentally illustrated; in particular it was shown that the difference of potential between the carbons was nearly independent of the current.

When a current of electricity passed through a continuous conductor, it encountered resistance, and heat was generated, as shown by Joule, at a rate represented by the resistance multiplied by the square of the current.

If the current was sufficiently great, heat would be generated at such a rate that the conductor would become incandescent and radiate light. Attempts had been made to use platinum and platinum-iridium as the incandescent conductor. But these bodies were too expensive for general use, and besides that, refractory though they were, they were not refractory enough to stand the high temperature required for incandescent lighting, which should be economical of power. Commercial success was not realized until very thin and very uniform threads or filaments of carbon were produced and enclosed in reservoirs of glass, from which the air was exhausted to the utmost possible limit. Such were the lamps made by Mr. Edison with which the institution was temporarily lighted.

The electrical properties of such a lamp were examined, and in particular it was shown that its efficiency increased and its resistance diminished with increase of current.

The building was lighted by about 230 lamps, each giving 16 candles' light, produced each by 75 watts of power developed in the lamp. To produce the same 16 candles' light in ordinary good flat-flame gas-burners, would require between seven and eight cubic feet of gas per hour, contributing heat to the atmosphere at the rate of 3,400,000 ft. lbs. per hour, equivalent to 1,250 watts, or nearly seventeen times as much heat as the incandescence lamp of equal power.

At the present time, lighting by electricity in London must cost some more than lighting by gas. What were the prospects of reduction of this cost? Beginning with the engine and boiler, the electrician had no right to look forward to any marked and exceptional advance in their economy. Next came the dynamo, the best of these were so good, that there was little room for economy in the conversion of mechanical into electrical energy; but the prime cost of the dynamo machine was sure to be greatly reduced. Hope of considerably increased economy must be mainly based upon probable improvements in the incandescence lamp, and to this the greatest attention ought to be directed. It had been shown that marked economy of power could be obtained by working the lamps at high-pressure, but then they soon broke down. In ordinary practice, from 140 to 200 candles were obtained from 1 H. P., developed in the lamps, but for a short time he had seen over 1,000 candles per H. P. from incandescence lamps The problem, then, was so to improve the lamp in details, that it would last a reasonable time when pressed to that degree of efficieny. There was no theoretical bar to such improvements, and it must be remembered that incandescence lamps had only been articles of commerce for about three years, and already much had been done. If such an improvement were realized, it would mean that it would be possible to get five times as much light for a sovereign as could be done now. At present electric lighting would succeed commercially where other considerations than cost had weight. Improvements in the lamps were certain, and there was a probability that these improvements might go so far as to reduce the cost to one-fifth of what it now was. He left the meeting to judge whether or not it was probable, nay, almost certain, that lighting by electricity was to be the lighting of the future.

The large building at Plum and Canal streets, Cincinnati, Ohio, used for generating electricity for the Brush Electric Light Co. was burned yesterday afternoon. The fire originated from a hot box in the shafting on the top floor. The loss will reach $40,000, and the insurance is between $20,000 and $25,000. The machinery is so injured that no electric light can be furnished for a week or ten days.

The *Railway Age* publishes a summary of railway construction in the United States for the year 1882. The account covers only the main track, and shows the construction in States and Territories. On 342 lines the aggregate is 11,343 miles, or about 2,000 miles more than in 1881, which exceeded any previous year by 2,000 miles. The construction is divided as follows: Five New England States, 53½ miles; four Middle States, 1,315½ miles; five Middle Western States, 2,077½ miles; eleven Southern States, 1,490½ miles; four in Missouri River belt, 2,063¼ miles; five in Kansas belt, 2,157¼ miles; five in Colorado belt, 1,165 miles; six in Pacific belt, 1,020 miles.

Our Mexican correspondent announces the arrival at the City of Mexico of F. M. Delano, Esq., and Major George W. La Rue. They report an exceedingly stormy voyage, in which even the Major succumbed to sea sickness, and was unable to leave his berth until their arrival in port.

Portable Electric Testing Apparatus.

(*Read Before the Franklin Institute, April 18, 1883.*)

By C. J. H. Woodbury, of Boston, Mass.

The use of electricity for lighting purposes has introduced a new element in the matter of testing such systems. Hitherto the sole object in testing telephone, telegraph and other signal lines was confined to purposes connected with the operation or repair of the apparatus.

Electric faults in the telegraph never injured person or property Contact with telephone lines never robbed a fire department of its right arm by destroying the fire alarm boxes. There is no instance of these weak currents ever setting fires or causing severe personal injuries like those which have been traced to electric lighting currents.

The difficulties connected with the introduction of the electric light have been inseparable with the use of a new form of energy, for the currents have been so much greater than those hitherto used that their application was virtually a new science. Twenty years after illuminating gas was known, the architect of the House of Commons specified that no woodwork should approach within six inches of a gas pipe.

Whenever an electric lighting current has been diverted from the system, it has generally given unwelcome evidence of its energy. Such occurrences, considered as an accidental loss of energy, are comparable to the bursting of a boiler or the yielding of a dam; but there is no chance of such extensive injuries to life and property from any mishaps resulting from the use of electric-lighting apparatus.

Wherever the use of a large amount of power is involved, the safely is dependent upon the facility with which the whole is held under control, whether it be the head of water against the water-wheel the steam in the boiler, or the electricity in the circuit The experience with the electric light is showing that these currents are more easily controlled than other forms of energy, as far as any elements of danger are concerned.

It is not necessary at this time to recount any of the fires caused by electric lighting, but I am not aware of a single fire of this nature which, in the light of present knowledge upon the subject, is not to be considered as a preventable fire. With proper and *continual* attention to insulation, construction of lamps and of switches, and in the incandescent system also the proper size of conducting wires and *closed* safety catches, there can be so little opportunity for fire from electric lights that, under these conditions, it forms the safest method of illumination.

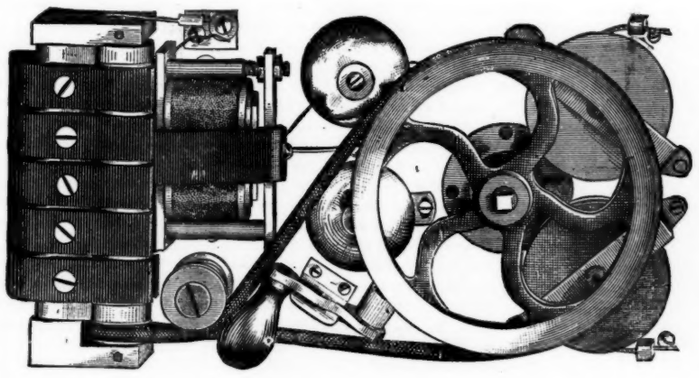
Most of the fires and other difficulties with electric lighting apparatus have been caused by the diversion of the current from the system at distant points, each leading to the earth, and very few accidents due to a conductor making a cross between two adjacent wires Two contacts are required in order to form the complete circuit necessary to stablish an electric current. If a single conductor leads to the earth, only a second one is necessary to divert a portion of the current from the system to the earth, the relative quantities of the current seeking the two paths being inversely proportional to their electrical resistances of the conductors

Such a diversion of the electricity causes first the commercial loss of electricity. If the contacts are of a nature to diminish the resistance of the circuit, then there is great liability of injury to the armature or commutator in most dynamo machincs. The fires have been produced where the electricity met with a conductor of sufficiently high resistance to convert the electricity into heat whose temperature is high enough to burn any combustible substance.

The instances were usually on a circuit where one ground connection already existed, and a stream of water leaking during storms, or from washing floors, running over the wires and to the earth formed a good conductor, which was soon removed, as the electricity dissociated the water, and then an arc was formed as the current strove to maintain itself. Pure rain water is a very poor conductor of electricity; but, in trickling over plaster or whitewash, it takes enough lime or salt into solution to increase its conductivity many times. In some instances, the water connected two wires of different potential. We see the same action when the current is let on an arc-lighting system. When the carbons touch, there is little resistance, and would be no light if the feeding apparatus was not arranged so as to draw the carbons apart, and thus present the resistance of the space of the distance between the two carbons.

In the early application of electric-lighting apparatus, ground return circuits were used as in other electrical circuits, but there were so many difficulties that it was abandoned, and metallic circuits are now universally used. I believe Prof. Edwin J. Houston, of Philadelphia, was the first one to indicate the dangers of using electric-lighting circuits with ground returns

If an electric-lighting plant is well constructed and installed in a proper manner, there is no certainty that it will remain in a satisfactory condition on account of the numerous changes, blunders and accidents to which it is subjected. It is important that each circuit should be provided with some apparatus for the purpose of making frequent tests of the insulation of the whole system. The most precise method is to use a galvanometer, with a rheostat and battery; but this involves delicate and expensive apparatus, which cannot be used by any one except an electrician, while the weight and bulk of galvanometer, rheostat and ten cells of battery renders it impracticable for portable use.



This engraving shows a portable instrument for the purpose of electric testing, made from my designs by Charles Williams, Jr., of Boston.

It consists of a Siemens armature in the field of a battery of five permanent magnets. There is no commutator, and the alternating current passes through the coils of a polarized electro-magnet which vibrates a striker between two gong bells whenever the circuit is electrically complete.

The armature is revolved from a driving wheel by means of a quarter-turn belt which passes around an adjustable guide pulley, whose position can be changed so as to give any desired tension to the belt.

At the end of the case are two reels, each of which contains steel tapes thirty feet in length, forming flexible conductors which are provided with spring clamps at their ends.

The driving wheel and the reels are turned by means of a crank which fits with square dowels, like a clock key, and when not in use is held by a spring-clip, as shown in the engraving.

The armature is wound with six thousand feet of No. 40 wire, and measures one inch in diameter by three inches in length. The whole is contained in a hard-rubber case an inch and a quarter thick, four inches wide and eight inches long and weighs three pounds.

The bell will ring through an external resistance of 7,000 ohms, when the crank is being turned about two hundred times per minute.

One of the armatures was provided with a commutator, and the following measurements taken with the resistance of the armature amounting to 400 ohms as the only resistance in the circuit:

Revolution of Crank Per Minute.	Electromotive Force in Volts.	Current in Amperes.
60	2.00	.0050
120	3.96	.0099
180	6 04	.0151
240	7.96	.0199

The whole efficiency of the testing apparatus depends upon its ability to detect any ground which could under any circumstances become an element of danger. The resistance of the arc-lighting circuits (cold) is very variable, owing to the irregular resistance between the tips of the carbons.

A number of measurements of long arc-lighting circuits show that 1½ ohms to a lamp is a fair estimate for the external circuit, as the connections are usually made. This, on a forty-light Brush circuit, would be 60 ohms, and when the bell of the testing magneto can ring through a resistance of 7,000 ohms, it is able to indicate a possible escape of six-sevenths of one per cent. of the current, which in the Brush system amounts to nine-hundredths of an ampere, or about four and a half times the quantity generated by the testing magneto, an amount of energy too small to cause any damage whatsoever.

The same methods applied to other circuits show still smaller results, as the resistance of a Brush forty-light circuit is greater than that of the circuit from any other dynamo.

With the low resistances used in incandescent lighting systems the limit of measurement is still greater. In a 100-light Edison incandescent plant this tester would detect a leakage of less than one twenty-fifth of one per cent. of the current used in the whole circuit, or, in this instance, it would show a leakage of one twenty-fifth of the current required for a single sixteen-candle power Edison lamp, which would amount to twice the amount of current generated by the testing magneto.

The method of using the instrument to test for ground connections is to fasten one of the spring clamps to a conductor leading to the earth, such as the stop-cock to a gas pipe or preferably to a water pipe, and the other spring clamp to the lighting system. When resistance of the insulation between the system and the earth is less than seven thousand ohms, the bells will ring.

If the crank is turned slowly, the bells will ring only through less resistances, and, by standardizing these testing magnetos by measuring the limits at various speeds by means of a rheostat, they can be used to approximately measure resistances by counting the speed of the crank necessary to ring the bells.

For testing the insulation of arc lamps, if one clamp is attached to one of the binding posts of the lamp, and the other clamp placed in contact with the various parts of the frame while the armature is revolving, the ringing of the bells will indicate imperfect insulation.

Whenever it is desired to test incandescent systems for crosses, this apparatus can be used for the purpose by disconnecting one of the main conductors from the dynamo and turning every lamp switch on the circuit; if the lamp sockets are not provided with independent switches, then such lamps must be removed. Care must be taken that the resistance box does not close the circuit. Then attach one of the spring clamps of the testing magneto to each main conductor, and a ring will detect the presence of a cross conductor. By switching off the various branches and testing in sections any fault can be located to that single branch, and the safety boxes furnish a means for further division of the circuit.

This apparatus requires no electrical skill for its use, is not affected by time or temperature, and can be used in any position. They have stood the test of over a year's constanture, without accident or deterioration of any nature.

The Future of Electrical Engineering.

As a practical science, it is only within the past few years that electricity has taken any permanent hold on the trade and development of the nation.

Its growth in this way has been slow, and the reasons for this are not very far below the surface.

Up to the invention, or, to speak more correctly, the practical application of the electric light, very small attention was given by any of the engineering profession to the subject, and the knowledge of electricity was confined to chemists and scientists, being looked upon by practical engineers as decidedly a laboratory question. The rapid development of the lighting powers of electricity, however, drew the attention of inventors first, and now of engineers, to the matter, and there is no reason to doubt that it is of the highest importance for the science and for the profession alike that they should become intimately connected with one another.

That this will be so, and that the mechanical engineers in the immediate future will hold the direction of electrical work, many facts go to show. It is particularly so with electric lighting. There is no scientific improvement in which the question of economy is so indispensable an item as in this, owing to the peculiarly trying competition to which it is subjected.

This economy, striking at the whole system, affects—1st, the means of producing electricity; 2d, the means of conveying it; and 3d, the utilization of it. Thus, whether the prime producer of electricity is a steam, gas or water engine, their economy results from a due exercise of mechanical knowledge in their design, and, as electricity can only be produced in large merchantable quantities by such machinery, the engineers have a great—perhaps, the major—portion of the system under their present control.

The scientific man who has developed the principle of certain means of making or using electricity, must afterwards hand over this principle to more practical and mechanical minds for useful development. The dynamo or generator of electric force well illustrates this point.

The Gramme machine, which was the early inception of the principle, has, under the successive mechanical improvements since applied, become a working success, even in the largest sizes, and no doubt, now that its lines of construction are clearly defined, many engineering firms will enter upon its manufacture, and reduce its cost by economies and the use of special tools.

The transmission of the electric force is at the present time occupying the attention of scores of busy minds, and the scientific world generally is almost weekly anticipating the discovery of some great further step in this direction.

The check from which electric lighting has

been for some months past suffering, although due in part to financial over-exertion, is yet largely to be accounted for by the commercial failure of the accumulator or storage battery, for the lack of which the trade is languishing, and in expectation of which, as an economical certainty, extensive electrical projects of supply are deferred.

It is a most fortunate circumstance for the needs of the world at large that the principle of the accumulation or storage of power was demonstrated when it was, as it has given to invention the basis on which to work, and it is not hard to estimate the annihilating difficulties with which the application of elec tricity would have been confronted without the promise of such assistance.

But it is in the *uses* of electricity that electricians, as distinguished from engineers, at present possess the greatest control. Lamps, telegraphs and telephones are of such delicate mechanism that their design and construction hardly fall within the province of manufacturing engineering, being more properly in that of instrument makers and clockwork.

Yet the question of economical production being of as vital importance here as in the other portions of the body electric, engineering talent and mechanism must be employed increasingly to cheapen and multiply manufacture

The blowing in glass of the globes of incandescent lamps is a case in point in which a move has been made.

Up to the present this work has been done by hand, but a machine has been recently set to work which forms these globes from a glass tube, not without the direction of a man, but by taking the work out of his hands, and revolving, blowing and heating under his control. Such a step is in the most necessary direction.

It is, perhaps, as a means of universally divided power, simpler, cleaner, more portable and cheaper than fuel and steam, that electricity is hoped for by the general community. It is the realization of this that will make electricity the "thing of the future," and give us the right to call ours the "electric age." That we are at a distance from it, immeasurable because unknown, cannot be denied, and if it is to be accomplished, it must be by engineering ability of the highest order.

The present is a period which admits of but one line of thought for a member of so varied a profession, but we have now, and shall increasingly possess, able minds among the scientific, military and manufacturing engineers devoted to these subjects by duty or inclination.

Two great factors are operating to produce attention—namely, the prizes, which are great, and the competition, which each year grows greater.

Electricity and Cyclones.

PROF. JOHN H. TICE'S THEORY OF THE ORIGIN AND NATURE OF TORNADOES.

The question of the electric nature of cyclones is a question of fact, and cannot be determined by balancing opinions. Facts alone can decide, by proving or disproving that cyclones are caused by electricity. I maintain that not only cyclones, but all the phenomena of the atmosphere, are electric in their nature and character. The facts upon which I strongly rely and adduce to prove the electrical nature of cyclones cannot be stated here, for they are too voluminous. The substance, however, is briefly as follows: A luminous or fiery cloud-spout is seen to descend from the clouds, which is met by a spout from the earth where the spout touches. Simultaneous with the flash everything free at the point struck explodes into fragments, is carried clean away, and generally hurled into the clouds through the vortex. Likewise, whenever an electric discharge takes place, ozone in stifling quantities appear with the flash. Combustibles are set on fire in the buildings struck, and destroyed. Flashes issue from the furniture in the houses, and sparks from the walls, like from an emery wheel. After night the tornado-cloud is invariably luminous—often not perceived in the daytime—and a wave-like flame on the earth confronts the cloud-spout as it sweeps forward on the surface of the ground.

I interpret these facts to say that this luminosity, these sparks and flames, are electricity, and hence that the whole phenomenon is an electric one.

I do not consider that it is an evidence of extraordinary mental perspicacity to perceive and make this inference, though it is an evidence of hopeless stupidity not to infer them. It is not surprising that men in all ages and in every stage of intelligence, when observing similar phenomena, should come to the same conclusion—namely, that they are identical with the lightning that flashes in the clouds. Our agnostics—the Greek for know-nothing—are bomb-proof against learning new facts from observation, consequently against acquiring new ideas from reflection. They do not look for and consequently will not see anything that conflicts with their preconceived notions. Because if they did, all their book-learning would be wiped out and go for naught, and their minds left a blank.

As far as I have been investigating the matter, Father Beccaria was the first to suggest the electric theory of storms. From the time he became acquainted with the discoveries of Franklin he became a most enthusiastic and indefatigable experimenter with electricity. In 1759 he published a book containing and defending the electric theory of storms. He was a man of most remarkable intuition, and his deductions were wonderful for their clearness and exactitude. Facts were at that time too few to verify the general theory, and consequently to deduce and verify subordinate principles. He, however, collected and adduced an immense number of pertinent facts that are fatal to and subversive of the mechanical theory now in vogue. A searcher after truth in the full meaning of the term, but conscious of his deficiency in knowledge of the subject matter, he adopted the only true method of acquiring information—namely, calm and impassioned observation, to learn and collect facts, and by experiment to verify the suggestions made by the facts while studying them. He knew, if once in possession of the facts, that sooner or later their lips would be unsealed and their secrets disclosed. How different was he from the present race of pretended investigators. Silently and quietly he pursued his investigations and experiments in his study and laboratory until he had discovered a great truth and had verified it, and then brought it before the public. But our noisy and fussy agnostics are constantly warning the public that they will soon electrify the world with some astounding discovery, and then disgust the public by a new rehash of dry-as-dust old matter. As discoveries they are failures, for they not only close their eyes to prevent them from seeing anything in conflict with their preconceived notions, but they deny the validity of the observations of others.

One of the experts (?) in the case referred to says I depended for the truth of my theory upon the bending of iron rails upon one of the railroads in the East St. Louis tornado. Without denying in words my statement, he said some allowance should be made for the exuberance of my fancy, which often led me into statements that had no foundation in fact. Unless he produces such a statement of mine, I brand him as a malicious calumniator. If any one had any doubt of the accuracy at the time, it should have been raised and settled then. But as it was not done, though published within a day or two after it had occurred, it must be accepted as evidence that it was known to be true It was left for one who was then not here and who knows nothing about it, and after a lapse of twelve years, by innuendo to call its accuracy into question. The occurrence took place at the terminus of the Wabash line, and there may yet be officers and employés who are cognizant of the facts. I urged at the time that these pieces—I think there were five of them, two only bent and three broken off—should be secured by the Academy of Science, not only as mementoes, but for future reference, examination and study. As from some of the leading members I found it had not been done, a week or two afterward I went over to secure a piece for myself. I found that the bent rails had been straightened, and the ends broken off taken away with other scrap iron. This is not the only time I urged upon the Academy of Science the preservation of tornado specimens for future use. In the Marshfield tornado I found the bark of a hickory-nut tree had been loosened from the roots to the top, but not thrown off, and still incasing the stem. The suggestion was ridiculed and the fact belittled by the agnostics. Without knowing what the facts were and the surroundings, they gave their opinion that the bark was loosened by the twisting and bending of the tree. Now, the tree stood in a dense grove in which the trees were very compact, a few only showing traces of the tornado, so there was neither room for bending nor twisting In fact, the tornado lifted at this point from the earth, and did not come down again for twelve or fifteen miles. It therefore did not pass through the grove, but over it.

Arago describes an exactly similar phenomenon, which occurred in a tornado at Mouville, France. He says: "The bark, unbroken, was so neatly detached from the tree that the trunk was taken out, and the bark formed a hollow cylinder."

Denial of facts is a short cut-off these men take to get out of a difficulty when cornered. In the Wisconsin suit my testimony states the lifting of a locomotive from the track, carrying it 70 feet and setting it down without turning it over. Mr. Watson, since dead, an astronomer of some note as a planetoid finder, was called on as an expert, not in his proper sphere as an astronomer, but in meteorology, a science he confessed he never had studied. He doubted the correctness of my statement about the lifting of the locomotive, because he had never heard of such a thing. But if true, he could account for it upon mechanical principles by sufficient whirl in the vortex.

The rebuke administered by Phidias is pertinent to all experts. He had called in a sandal maker as an expert to decide whether the sandals upon the feet of the statute of Jupiter Olympus—one of the seven wonders of the ancient world—were properly adjusted. He pronounced the sandals all right, but the leg above was not to his notion. Phidias reminded him that his judgment was confined solely to the sandals; any opinion of his beyond them was worthless. A strong wind—ah, there's the rub with mechanical theorists. There is no wind, strong or otherwise, when and while the tornado does its destructive work. But they assume that there is one, and that where it enters the vortex its velocity is from 60 to 80 miles an hour, and within a few hundred feet to center of the vortex its velocity is accelerated to 800 miles and upward per hour. Whatever may be the velocity with which air moves in the vortex of a tornado—in my new work I prove it by indubitable facts to be not less than 775 miles per hour—outside of the immediate influence of the vortex there is generally a dead calm.

In my unpublished work above referred to I conclusively demonstrate that the assumed wind of the agnostics in tornadoes is a myth, the whim of their exuberant imaginations, and of such stuff as dreams are made of. I adduce facts that in tornadoes stone houses were leveled down to the foundation and every stone swept away, while within sixty feet from where they stood straw sheds were untouched; that a spade leaning against a tree, standing within four feet of a house swept away, was not thrown down; that hay-bins were lifted from the hay and carried off; but not an atom of hay was taken away. In the latter case I should like to know how it is possible with a wind striking the bins with a velocity of 800 miles an hour to leave the hay unmoved when uncovered.

In the remainder of cases above mentioned the facts show—what is the general appearance—that outside of the whirling vortex there is a calm air.

The closing of eyes so as not to see these things will avail no longer; the denial of facts attested by unimpeachable witnesses is simply suicidal

The lifting of the locomotive in the East St. Louis tornado is called in question. When there must be yet hundreds of living witnesses in St. Louis to testify to the fact, it must recoil upon those who make it, and be fatal to the interest in behalf of which it is made. I caution all to be careful in indulging too liberally in denials. Because when my facts, collected with so much care from all authentic sources, including the Signal Office, are published, those who have not been cautious will stand naked before the world as self-convicted agnostics.

On the Unequal Heating of the Electrodes by the Electric Discharge.

BY GIOVANNI MUGNA.

The electrodes of the Holtz machine consists of two equal hollow metal spheres standing upon glass rods capable of a sliding movement. The interior is connected by caoutchouc tubes with a slender U-tube, in which a short column of alcohol moves up and down. In experiments with a Ruhmkorff inductorium, fitted with Ruhmkorff interrupter, one of these spheres was combined directly with the one pole, and the other with the remaining pole, but with the intercalation of a galvanometer. With increasing intensity of the current, and at the same distance of the electrodes from each other, the excess of heat at the negative electrode, as compared with the positive electrode, increased. The result was the same if the intensity was constant, but the distance of the electrodes was lessened.

On using a Holtz machine, with or without the introduction of the condensers, the same result as above was found with respect to the influence of distance. With the condensers the negative electrode showed a much greater excess of heat over the positive in equal times than without them. If one of the globular electrodes is provided with a point, the other electrode is more strongly heated.

Underground Communication.

THE COMMITTEE OF THE ELECTRICAL COMPANIES PREPARING FOR ENERGETIC WORK.

At the meeting of representatives of telegraph and electrical companies last Friday to consider the subject of underground electrical communication it was resolved to appoint a general committee to take charge of and push the matter. The committee has been appointed as follows:

Colonel Thomas J. Montgomery, H. L. Bailey, D. H. Bates, A. B. Chandler, W. A. Childs, Governor Grover Cleveland, H. Cummins, L. E. Curtis, J. P. Davis, S. B. Eaton, Mayor Franklin Edson, C. R. Flint, R. R. Hazard, E. Holmes, C. B. Hotchkiss, W. M. Ivins, F. H. May, G. S. Mott, H. W. Pope, C. W. Price, A. C. Richards, J. Eliot Smith, Elihu Thomson.

The first meeting of the committee was held the 23d inst. at 115 Broadway, and an organization was effected by the election of J. P. Davis, Chairman; R. W. Blackwell, Treasurer, and W. C. Behrens, Secretary. A committee consisting of Mr. Davis, Colonel R. R Hazard and F. H. May was appointed to nominate permanent sub-committees on electrical and mechanical devices, law and franchises and business organization.

Another Edison Company in Pennsylvania.

Some of the principal capitalists of Danville, Penn., have organized a new company, known as the Edison Electric Illuminating Company of Danville, with a capital stock of $50,000. Arrangements are being made to build a 200 horse-power engine and all the necessary equipments. The town has been paying extravagant prices for gas for several years, and this new enterprise is hailed with delight by the citizens.

Some Serious Considerations Concerning a Governmental Telegraph.

We extract some very interesting remarks upon above subject from a pamphlet just handed us:

Colonel J. A. Price, an incandescent and iridescent electric illuminator of great brilliancy, has suddenly arisen in the State of Pennsylvania.

This military gentleman recently delivered, before the Scranton Board of Trade, an address on "Governmental control of electric communication" in general, and the unregenerate cussedness of the Western Union Telegraph Company in particular.

This address takes rather a wide range. It touches slightly upon the domain of philosophy. It treats briefly of the origin and aims of government. It institutes a comparison between America and Europe, in which the effete governments of the latter suffer, as usual. It parades statistics of immigration, of population, and of wealth. It ransacks the Patent Office reports. It patronizes the British lion. It glorifies the American eagle, and winds up with a brief but brilliant description of the triumph of Germany, and the defeat of France in the Franco-Frussian war.

The address evidently made a marked impression on the Board of Trade, as its officers united with others in a written request for its publication Fortunately for the world, it has been published; and the publisher informs the public that "it will be found replete with statistical information," and will be sent to applicants "on receipt of ten cents" per copy.

After much study and long reflection, the Colonel has ascertained that "men are human," that "all government is of men," and that "ours is an ideal Republic founded on the suffrage of millions, with a mission" to gratify very much and restrain very little.

The Western Union Telegraph Company, according to the same authority, is a "system of Cyclopean plunder," with a capital of $80,000,000, composed mainly of "stock dividends in which villainy and legality are nicely but ferociously compounded."

This is not only nicely ferocious, but it is also ferociously nice. It is not only a nice ferocity, but it is likewise a ferocious nicety. The idea is good, whichever way one chooses to put it. The invectives of Junius contain nothing like it.

The Colonel's chief grievance against the Western Union Company is apparently the amount of its capital This, he says, is inflated or watered, and is quadruple the actual value of the property. If this be true, what bearing has it on the question at issue, unless the company increase its rates as it increases its capital? No charge of this sort is made; on the contrary, the tables cited by Colonel Price show an actual decrease in the rates since 1867 of about sixty per cent.

The Colonel says, in support of his views in favor of a Governmental telegraph, that "the cardinal elements of man's existence upon the face of the earth are the comparatively free use of land, water, light, air, and communication with his fellows."

Now, it is well known that the Western Union Telegraph Company is slightly addicted to the habit of "communication." If Colonel Price is to be believed, it is also addicted to the use of water, contrary to his wishes. It is, therefore, manifestly his intention to deprive the Western Union Company of these two "cardinal elements" of existence.

To do this would be downright cruelty. The Western Union Company has probably little or no knowledge of farming, and no one even in Pennsylvania is likely to offer it the free use of any land for farming purposes. Therefore, when Colonel Price shall have made this "ideal Republic" the sole agitator of the communicator, and shall have cut off the Western Union Company's supply of water, he will have deprived it of all the cardinal elements of existence except those of light and air—a diet so thin, and so devoid of nutriment, as to lead the friends of that Cyclops to anticipate the most melancholy consequences.

"Progress," quoth the Colonel, "is built upon knowledge, and knowledge in turn springs goddess-born from the brain of the race in frequent and constant communication."

The Colonel's rhetoric "is just too awfully nice for anything," but his architecture is somewhat faulty.

It will be observed that he erects the superstructure of progress upon the foundation of knowledge, and the foundation then "springs, goddess-born, from the brain," etc.

What becomes of the superstructure when the foundation springs in this eccentric manner? How can it spring from the brain, if it be lying under the edifice? How can progress be erected upon knowledge before knowledge is born? The architecture is apparently of the order known as mixed.

It calls to mind an advertisement written by some waggish boys and posted on the village store They had affixed to the notice the name of a neighbor whose odities and illnature were confidently relied on to supply the fun. It ran thus:

FOR SALE—ONE MILCH CALF; HE IS a good one. Call and see her. You will be pleased with him. It is a beauty. A B.

Mr. A. B. having been found intently reading the advertisement was asked for an explanation. He replied very petulantly:

"I don't know nothing about it. It's my wife's hand-write—" adding, after a pause, with increased petulance, "I don't see what she wants to sell the calf for now, anyhow, because it isn't born yet."

The Colonel's foundation is very like the old man's calf. His language like that of the boys is slightly mixed, and like the boys he is also "a little too previous."

"Mind," we are told by the Colonel, "has rubbed against mind until all are bright; hence, governments owe their people the greatest facilities of communication."

This is what may be termed a logical sequence. If we take one mind and rub it against another mind "until all are bright," it will follow as a matter of course that governments will owe the people greater facilities of communication. "If not, why not?"

"Nothing," says the Colonel, "should be left to individual enterprise that pertains to the welfare of all."

This is a terse exposition of the functions of government, and we may now confidently look forward to the day when this "ideal republic" shall have become the "Cyclopean" tailor and the colossal washerwoman of the North American continent.

The orator stated to the Scranton Board of Trade a horrid fact which has hitherto been studiously concealed from the American public. It is this: Before the British Government took possession of the telegraph the charge for transmitting a message between London and Penarth Docks was sixpence, in addition to the rate charged on a telegram between London and Cardiff. This is probably too true.

The people of Cardiff having this signal advantage of the people of Penarth Docks, what could possibly have induced the "Cardiff Giant" to emigrate to the United States?

The statement in regard to the extra charge of sixpence against Penarth Docks is said to have created a most profound sensation in the Scranton Board of Trade, and the sympathy of that body with the Penarth Dockers, and its indignation against the Western Union Telegraph Company are reported to have been "nicely but ferociously compounded."

"America," the Colonel assures us, "has one government, and a population of 50,155,783, with a capacity of increase to 400,000,000." These people, we are told, "are absolutely and unqualifiedly helpless" as against the Western Union Telegraph Company. There is but one remedy, he says, and that "is Governmental control." This may be true, as respects the 350,000,000 who are unborn. They cannot reasonably be expected to stand up, just at this time, against that redoubtable Cyclops; but surely the 50,000,000 now alive should not give up without a struggle. It is a curious fact that while the American people are represented as utterly helpless and prostrate before the Western Union Telegraph Company, the inventors, or rather the applicants to the United States Patent Office for letters patent, who form but a small fraction of the entire population, appear to have no difficulty whatever in controlling the Creator of the universe.

"The secrets of the Creator," says Colonel Price, "are being demanded, not singly and alone, but in battalions," by these gentry.

Now this, to say the least, is extremely impolite on the part of the patentees. If it be true, the life of the Creator is undoubtedly made a burden to him If any portion of the American people have the persistence and the power to make the Creator wish that he had died in his youth, or that he had never been born, it is the ordinary holders of, and the ordinary seekers after, letters patent.

Colonel Price is my authority for stating that the U. S. Patent Office has issued 267,313 letters for mechanical invention. The Creator, therefore, has been compelled to give up 267,313 secrets, no doubt, however, with a greater or less degree of reluctance, and not without a struggle, although apparently a vain one.

It is greatly to be regretted that more specific information has not been given us in regard to the surrender of these secrets. It would be interesting to know whether the Creator gave them up because he couldn't help it, or whether he surrendered them rather than have any fuss with the patent-seekers. It appears certain, however, that he surrendered them on demand, unconditionally, and—"in battalions."

Colonel Price's courage seems to rise as the difficulties to be encountered increase. If his fellow-citizens oppress him, "I am helpless," he cries. If his Government oppress him, he would expostulate with it, and, if necessary, revolutionize it. But, if it be a question between his Creator and himself, he will submit to no nonsense. He will not permit the Creator to keep even his own counsel, but will demand his secrets "in battalions" Can't you make it squads, Colonel? Why insist on battalions?

"America," says Colonel Price, "has pushed to the front and leads the field. She has no competitor. All are distanced." She is "iron-ribbed from ocean to ocean and from zone to zone," and he might have added copper-bottomed also. Immigrants to the number of 13,000,000 have already arrived; but they are only a committee, as it were, sent forward to prepare the way for their friends in the fatherland. The noise of "the greater moving mass to come" is heard like "distant thunder" (probably "backin' der droonks oop"); and yet he says, "this *noiseless* growth must not find us lacking." He publishes tables showing an increase of 4,000 per cent. in the value of property in the United States since the year 1800. He fairly revels in this growth of wealth. He rejoices in the increased value of everything except telegraph property, and especially the telegraph property of the Western Union Company. The prosperity of that "Cyclopean system of plunder" seems to wring his heart with unutterable anguish. The growth of the United Statess, he tells us, is "marvelous," and "fairly incomprehensible in magnitude," and yet this country has no Governmental Telegraph. He tells us that the object of the British Government, in "assuming control of the telegraph, was to stimulate trade, to economize capital, to facilitate commerce, and to encourage manufactures." He tells us that in 1840 the wealth of the United States was only one fifth as great as that of Great Britain, and that in 1880 the wealth of the United States was six billions greater than that of Great Britain, although Great Britain had for eleven years assiduously stimulated trade, economized capital, facilitated commerce and encouraged manufactures with a Governmental Telegraph. How can this be accounted for?

Colonel Price styles the purchase and absorption of other telegraph companies by the Western Union Company "a system of Cyclopean plunder," apparently because, in his opinion, it paid from five to thirty-fold more than the value of the property. He tells us that the purchase of the American Telegraph Company's lines was a "flagrant outrage on common honesty," and that the capital stock of that company, amounting to $5,833,100, had been *diluted* some ten-fold.

It is manifest that the Colonel has no correct knowledge of the extent of the American Company's lines or the value of its property.

He charges that the Western Union Company *ruins* its competitors. If his figures be reliable, that company has always paid for the property of these competitors vastly more than its value. This seems to be a novel kind of ruin—a kind to be courted rather than shunned.

If the purchaser who pays tenfold too much for what he buys be a "Cyclopean" robber, what kind of a Cyclops would the Colonel call the *ruined* seller?

The Colonel appears to have some exclusive information in regard to the pneumatic tube which he speaks of as "outrunning steam and surpassing electricity." "In it," he says, "we see time reduced to a minimum in the delivery of articles that have length, breadth, thickness and weight—letters or merchandise, perhaps; we see hours shrunken into minutes—from ocean to ocean a day's transit."

Now, the writer has never had the pleasure of seeing a pneumatic tube run; but, if it surpass a well-lubricated streak of lightning in a short race "from ocean to ocean," it is no slouch. It is a pity, however, that its carrying capacity is limited to articles having length, breadth, thickness and weight. The customer seeking transportation of packages having none of these qualities is certain to turn up.

The absurd idea seems to have found lodgment in some minds that, if the Government take the telegraph and reduce the rates to a merely nominal price, telegraphy must necessarily be cheap. The telegraph business cannot, of course, be carried on without great cost, and the lower the rates the greater will be the expense. If those who use the telegraph do not pay in tolls enough to maintain it, the expense must be paid in some other way. In case of Government control of the telegraph, the interest on the cost of the plant and the deficits, if any, must necessarily enter into the taxation of the people.

Colonel Price seems to favor a Governmental telegraph, mainly for the purpose of extending its use by cheapening the rates; but people generally, no matter what the rates may be, will seldom, and a vast number will never, use the telegraph, for the simple reason that their avocations do not require its use. One of the questions to be determined is, whether or not the millions who do not use this means of communication should be taxed for the purpose of giving lower rates to the thousands who use it daily.

The writer is concerned in the welfare of many thousands of people who are vitally interested in the destinies of the telegraph, but who are not mentioned by Colonel Price. Their claims are worthy of serious consideration in connection with the radical changes proposed. Allusion is made to the telegraphers, who, in fidelity, industry and intelligence, are second to no workers in the world.

Taking Morse's invention when the Government had discarded it as impracticable for business purposes, by their skill and industry they have built up the unrivaled telegraph systems of the United States.

What does Colonel Price propose to do for them under his five cent or ten cent tariff? Is their compensation to be fixed on the same basis? If so, the efficiency of the service cannot be maintained.

Colonel Price thinks the telegraph could be made profitable at one cent per word, or, say, ten cents for a message of ten words, although he cites Mr. William S. Crosby, of Chicago, as a "five-center," and commends him as "a gentleman thoroughly conversant with the cost of construction and the expense of maintenance of telegraph lines."

(To be continued.)

A new hotel at Old Orchard Beach is being completed by Mr. Samuel Haines.

Telephonic.

The Circle.

APPROACHING REMOVAL OF THE TELEPHONE FACTORY—LONG-DISTANCE TELEPHONING PRACTICALLY CONSIDERED—IT WILL NOT PAY, BUT CINCINNATI, LOUISVILLE AND INDIANAPOLIS WILL SOON TALK.

INDIANAPOLIS.—"The Circle" is said to be the exact geographical center of Indiana. If not the hub of the universe, the citizens of the Hoosier Metropolis evidently consider it the "given point" from which he must begin who would solve the Presidential problem.

Upon a subject quite as likely to eventually, though mildly affect them in a business way, the people here are not so well informed. That "The Gilliland Electric Works"—one of seven factories that are supplying the world with the essential portions of the telephone, is to be removed to Chicago in September, seems to have escaped the attention of the local item gatherer. The factory is situated about two miles from "the circle," and therefore about two miles out of the world, except that it gives employment to about 150 men and fifteen girls of Indianapolis. Its capacity is at present over one hundred completed "bells"—that is, everything that one sees of a telephone, except the telephone proper or ear piece—per day, and, in spite of the early removal determined upon, this is to be forced up to one hundred and fifty per day, so much greater is the demand than the supply. When it is known that everything from the tiny knob of brass that forms the tongue of the signal bell to the intricate "armature," with its mysterious fillings of wire, thin as the finest human hair, even when covered with silk, is made from the raw material in the establishment, its loss as one of the industries and attractions of the city may be appreciated. One year ago "the Western Electric Company" was formed, with a capital of $1,000,000. Into it the four formerly independent factories at New York, Boston, Chicago and Indianapolis were pooled. The company, though it has an interest in other telephone factories in this country and Europe, have found their combined facilities unequal to keeping pace with the increasing demand. They are therefore erecting, at the corner of Clinton and Van Buren streets, Chicago, a building that will be one of the largest in the country, being 150 by 300 feet and six stories high. Into this, when ready, the Indianapolis and Chicago business will be removed, for the obvious business reason of concentration and its consequent economy.

Long-distance telephoning, since the successful experiments between Baltimore and Chicago and New York and Chicago, is the electric question of the hour. The last few years have been marked with great discoveries in the regions of electricity, and yet it will not strike the average reader as extravagance to say that there lies yet beyond as vast a field for exploration, and a more mysterious, if not more awful one, than Columbus entered when he dared sail out into the unknown ocean—if to return, God and his own prescient soul alone knew. It is this uncertainty that allows the imaginations of speculators in electric inventions to run riot, and which is affording a rich harvest to sharpers, whose "little knowledge" of electricity is "a dangerous thing"—to their victims. In a science which may never become an exact one, and where the nature of the agency can only be feebly guessed at from its "manifestations," and its habits learned only by experience, it is the "practical scientist" that must be appealed to for really useful information. Mr. E. T. Gilliland, who a few years ago was known in Cincinnati as "our Western Edison," and who has proved himself almost *the* practical electric expert of the country, is eminently such. To the technical knowledge that enables him to superintend the intricate details of the manufacture of all kinds of electric apparatus, and to meet competition as perfector and inventor, he unites a broad knowledge of their application that makes him one of the few men, in any position in this world, whom it would be difficult to replace—although it is true that there can be no vacant chair in this life that cannot be filled, and worthily, too. Hence we find the Western Union operator and expert of six or seven years ago not only the supervisor of many of the great Western Electric Company's affairs, but see him the President of the Missouri and Kansas Telephone Company, with its capital of $1,000,000, and of the United Telephone Company, with a capital of $700,000, the two corporations controlling all the telephone business and rights in Missouri and Kansas, except those in the city of St. Louis. His views on long-distance telephoning are therefore given with confidence in their value and general interest. In response to pertinent inquiries, he said, substantially:

"It has been demonstrated that it is entirely practical, with the new compound wire, to hold a telephonic conversation between Chicago and New York City. The same wire, in theory, as that for which the Harmonic or Postal Telegraph system have purchased the exclusive right, was tried years ago, but at that time it was found that the copper covering of the steel core (which latter is necessary to give the copper wire the tensile strength to sustain itself) would not stand the necessary joints and bending. This difficulty has been overcome by putting on the copper by electro deposit.

"Without knowing what royalty would be asked by the owners of the patent, I believe that the cost of the wire itself will prevent telephoning at as great a distance as you have named ever becoming 'popular,' in the business sense of that word, and as an investment I doubt if it can ever be made to pay. When we first experimented between cities, and we talked in the very earliest days as far as 400 miles, we used a light wire of high resistance—a wire that could be put upon eighteen poles, and which weighed not more than 100 pounds to the mile. Some of us even then maintained that a large wire of low resistance—as is now known to be correct—was the thing; but inter-city telephoning was an experiment, and we consulted economy. To talk over the twelve hundred miles between Chicago and New York there must be used either the compound wire or an iron one several times as heavy—an impracticable size. The copper wire would require about thirty-six poles to the mile, and I have roughly estimated its cost at $400,000. Only one wire can be used upon one set of poles, for even at the extreme ends of long cross-arms, at such a distance what was said to one wire would be heard on the other and *vice versa*, owing to induction. In fact, we find it impractical from this reason to put more than one wire on one set of poles for distances greater than three miles—four miles being the very limit, even if far apart."

"Won't this induction trouble be overcome?"

"If it is, the inventor can make millions of dollars. No remedy is yet known that is not more costly than the disease. If it was overcome, telephoning would be brought nearer to a par with telegraphy on the score of cost of wires, though the latter would still have the advantage of being able through the 'quadruplex' of making one wire do the work of four, or, through the harmonic system, of eight—things impossible in telephoning. But to resume: Grant—which I doubt, as telephony makes no record—that you could keep a New York wire busy for ten hours a day, at a dollar for five minutes' conversation. It will practically take five more minutes for every connection between the parties seeking to converse—or the income would be six dollars an hour, or sixty dollars per day—not the interest on the $400,000 invested, to say nothing of the cost of maintenance of the line. Nay, more, in so long a circuit there would be 'trouble' at some point much of the time, and to get continuous service a company would have to put up a second wire, and necessarily a second set of poles."

"Then, telephoning for, say, one thousand miles, is possible, but not probable?"

"Exactly. For distances of one hundred miles or a little over, groups of cities, however, will be united by telephone, and within a short period, under what is known as the 'extra territorial' license system, Louisville, Indianapolis and Cincinnati will be in daily communication with each other by telephone. For this purpose a No. 8 or No. 9 wire will be sufficient, the one having a little over 14 ohms resistance and weighing 380 pounds to the mile, and the other nearly 16½ ohms resistance and weighing 320 pounds to the mile."

"Will the ocean ever be telephoned under?"

"In that case there are electric impossibilities in the way, so far as present invention and knowledge go. As I have said, for almost any distance by land the obstacles are only mercantile, but as to the sea, the telegraph stopped at its ebb-tide for years, and the telephone halts on its shore for the present."

The electrician would have added, "and forever," perhaps, had he not been familiar with the wondrous progress of the last quarter of a century in all things into which enters "electricity"—the term applied by the sons of science to the great Unknown, which is to give its name to an "age" of history. It may be that in none of its usefulness is it to be curbed,

"Like Amru, pausing at the sea."

For already by it, in one of its forms,

"Earth o'ercome, old ocean's tides are taught
Submission to the mightier waves of thought."

L. O'S.

Perfect Interference of Sound by Telephone.

Suppose we have two telephones having the poles of their magnets similarly placed, and so connected with a circuit that a current will traverse their coils in the same direction. It is evident that any electric current passing will cause a simultaneous movement in the same direction in the diaphragms of both telephones. Now, if we conceive the current reversed in one of the telephones, the motions will have opposite signs. It follows, then, that the currents due to the vibration of the diaphragm of a third telephone in the circuit will produce in the two telephones vibrations of *opposite phases;* the sounds produced, therefore, will differ by a half wave length. The same current which in one telephone produces a condensation will in the other produce a rarefaction.

The experiment, as successfully tried in the physical laboratory of Dartmouth College by Professor Emerson and myself, was arranged as follows: The mouths of two similar telephones were placed before the extremities of a Y-shaped tube, and the sound from both telephones conducted to the ear by rubber tubing. A reversing switch was placed in the circuit, by means of which the direction of the current in one of the telephones could be changed; in this way could be produced at will coincidence or interference of sound. Each branch of the Y-tube was of rubber, so that either arm could be closed by pinching. Organ pipes of various lengths were sounded near a telephone in a neighboring building It was found that, when arranged for interference, the pinching of either of the branch pipes produced a very decided increase in the intensity of the sound; when reversed, an equally decided decrease. The inequality in the intensity of the sounds due to the two telephones was found to be the chief difficulty in producing complete interference; but by partly closing one branch, so as to weaken the stronger sound, the effect was much improved. In several trials the interference was complete, no sound whatever being audible. The rapid reversal by the switch gave a sharp contrast between the strengthening and the weakening effect.

This method of demonstrating the phenomenon of interference has obviously the advantage of applicability to sounds of any pitch. With singing, the interference was very satisfactory, especially with the lower notes; in conversation, however, the sound is not so much weakened, but the quality is perceptibly changed. The vowels seemed to suffer much more than the consonants.

Telephone vs. Telegraph.

A few days ago a gentleman in Hartford, Conn., had occasion to communicate with a friend in a town some forty miles distant, and wanted an answer before the departure of the 10:30 A. M. train. He went to the telephone office, but as their wires were crossed, he had to resort to the telegraph, and was told that he might have an answer "in about an hour." At 10 o'clock he called for the answer, but none had been received He then went to the telephone a second time, and was able to communicate and obtain the desired information in less than ten minutes, and at a cost of only fifteen cents. The answer by telegraph was received at 10:19, and the dispatch and reply cost fifty cents.

The *Inter-Ocean* remarks: "Since Chicago got telephonic communication with New York, it enables her citizens to transact business without exposing their persons and morals to the dangers that lay thick about Hell Gate. No wonder New York is bad, when she asks all the world to sail into her harbor through such a channel." The editor of that paper has evidently forgotten the old saying about people who live in glass houses.

By a new telephonic invention a whisper can be heard at a distance of 750 miles But that is nothing. When a farmer's wife goes to the door and faintly whispers "Come to dinner," it can be heard across a ten-acre field without a telephone.

A New Stock Telegraph Company.

The Commercial Telegram Company, whose offices are in the Equitable Building, propose to render the same service that is now done by the Gold and Stock Telegraph Company, and expect to attract customers by the use of superior instruments, the invention of Mr. Stephen D. Field, through the aid of which the quotations at the Stock Exchange can be ticked out in less time than now required. By the present system, the time elapsing between a transaction on the floor of the Exchange and a record of it upon the tapes in the various brokers' offices varies from ten to twenty minutes, and when business is brisk the instrument cannot work fast enough to record half the transactions. The printing wheel in the ordinary instrument makes about eighty revolutions a minute, while the wheel in Mr. Field's machine makes about 175 revolutions. The appearance of the printed tape is about the same in both systems. The Stock Exchange now undertakes to collect the quotations and record of its business by its own men, and this information will be transmitted to the Gold and Stock and the Commercial companies by private wire. How soon the customers will receive the information will depend upon the rapidity with which the instruments do their work. The new company will begin to put in instruments about the 1st of June, and their charges will be the same as those of the present company—$25 a month. The officers and directors of the company are: S. W. Fullerton, President; Luther E. Shinn, Vice-President and General Manager; John B. Scott, Treasurer; George W. Casper, Secretary; Richard C. McCormick, Dumont Clarke, E. W. McClure, Stephen D. Field, George L. Hutchings, William T. Messeran, John P. Dickenson and William A. Park.

New Yorkers can now converse with Chicagoans through the telephone. It is much more healthy for the New Yorkers than to go to Chicago to do their conversing. A Chicago sand-clubber can't knock all New York down through the telephone.—*Norristown Herald.*

TELEPHONIC PROGRESS IN MEXICO.

The Telephone in General Use Throughout the Country.

NUMEROUS COMPANIES FORMED IN CONNECTION WITH THE PARENT ORGANIZATION.

The interest manifested in Mexico by the American people is increasing daily.

The Americans have no doubt a larger amount of capital invested in Mexico than any other foreigners having initiated many enterprises during the past five years.

Among these is the Mexican Telephone Company which began to place its wires in June, 1882, and in eight months afterward was making more than its expenses. The great proportions which this company has since attained are shown by the following statistics:

In this city there are 308 miles of wire and 551 telephones in operation. The estimated length of telephone lines in the Republic is 1,250 miles. The estimated number of telephones is 3,000.

The Mexican Telephone Company of the City of Mexico has the following officers: F. M. Delano, President; James H. Howard, Vice-President, and J. D. Haines, Secretary.

This company owns all the telephones used by the sub-companies in the Republic. It furnishes telephones and all supplies appertaining to the business to the interior companies, which may be properly considered as branches of the parent one which holds a valuable federal concession as well as concessions from the States and city governments.

Mr. George L. Wiley, the present General Manager of the Mexican Telephone Company was elected on the 7th of March last. He was several years Superintendent of the Metropolitan Company of New York, and also Vice-President and General Manager of the Central Telephone Company. Since he came here he has by his excellent business capacity rapidly promoted the Mexican Telephone Company's interest, and it may be reasonably expected that the number of telephones and miles of wire will be doubled during the current year.

Among those who joined the staff this year is Mr. S. T. Wyatt, who was formerly at the head office of the Mexican Telephone Company in New York, and is now the company's auditor in Mexico. He is a talented and agreeable gentleman and has already gained a host of friends.

The Mexican Telephone Company have the exclusive right to use the Bell Telephone Company's patents in this Republic. In this city their customers include the leading bankers and mercantile houses, as well as the Government departments and newspaper offices.

The telephones are in constant use and the offices are open night and day.

Mr. F. M. Delano, the President of the Company, was to have sailed from New York for Vera Cruz on the 12th instant, and will doubtless be in this city within a fortnight. He is a spirited capitalist and may probably engage in some enterprises that will promote the advancement of the country.

The Mexican Peninsular Telephone Company was formed in New York last month. It has for its object the introduction of telephone lines in the states of Chiapas, Campeche and Yucatan, and the establishment of a sub-marine cable between Progreso, Yucatan and Havana, Cuba.

For the last two months the Western Union Telegraph Company has been working its line between New York and Chicago with the Wheatstone automatic system, which for nearly five years has been in constant use in England, where it is regarded as a valuable system for use in any office doing a large business. The principle of the Wheatstone apparatus is that upon which all automatic systems are based. A paper stencil is prepared which, passing through an apparatus of great delicacy, makes and breaks the current in accordance with the perforations. The result appears at the other end of the line in the ordinary dots and dashes of the Morse alphabet upon a tinted strip. The speed of the instrument is limited only by the ability of the transmitting machinery to indicate every perforation in the paper strip. When the dots and dashes at the other end become blurred or run together, it is evident that the despatching is done too fast. Two hundred words a minute is about the average speed attained, but under favorable conditions three hundred words are possible. Messages are sent and received over one wire at the same time. A reporter of the *Evening Post* was shown the apparatus to-day working in the Western Union office upon the regular Chicago business, one instrument sending and another receiving at the rate of about two hundred words a minute, or eight times faster than one man could do the work by the ordinary system. When a written message is received for Chicago it is first given to a "puncher," who punches out upon a strip the holes which correspond to the appropriate letters wanted. A good puncher can do about thirty words a minute, and one specially expert man does forty words a minute. Five men are kept busy preparing the slips for the machine, which has not work enough and is obliged to stop now and then and wait for the "punchers" to catch up. The messages which come in on the tape are given to typewriters to put into ordinary writing, and the one instrument keeps eight girls busy in transcribing.

The matter has passed out of the domain of experiment, according to the officers of the company, and there is no reason to doubt that the system is destined to great extension. It is especially valuable where wires are scare and men plenty, for over one good wire ten times as much business can be done as by the Morse system. In England, when long speeches are to be sent by telegraph, the company sends a dozen "punchers," with their little instruments in their pockets, and the strips are prepared right in the hall from the stenographers' notes, and by the use of a Wheatstone transmitter the speeches can be sent over one wire as fast as they are delivered. The officers of the Western Union Company are perfectly satisfied with the results, and the system will be extended to other lines. About the same number of persons are needed for the work, but only about one-tenth as many wires In case of accidents, storms, and a consequent loss of available wires, the system will be invaluable.

A meeting was held at Davenport, Iowa, on the 21st inst., of stockholders of the Midland, the Central and the Western Telephone companies. The outcome of the meeting, which was private, is said to have been that the representatives present favor a grand consolidation of these three companies, controlling Ohio, Indiana, Illinois and Iowa. One-third of the consolidated stock will be sold to the Bell Telephone Company, as a guarantee that the stock will not pass into other hands, which may be opposed to the Bell people. The Western Telephone Company has now exchanges in some fifty towns, such as Muscatine, Clifton, Lyons, Ia., and Coal Valley, Milan, Rock Falls, Sterling, Geneseo, Cambridge, Rock Island and Moline, Ill. The other companies, the Midland and the Central, are also working numerous toll lines. A stockholder of the Iowa Telephone Company states that the company is likely to go into the consolidation. It is agreed that the new company may buy and manage any independent lines and small companies which are now, or which may be, organized.

Thermal Theory of the Galvanic Current.

J. L. Hoosweg finds that there is always an evident decomposition, when the thermo-electric equivalent of electrolysis exceeds the electromotive force of the battery. He deduces from his experiments the following conclusions:

1. Every manifestation of electricity is a consequence of the disturbed thermal currents at the point of contact between two heterogeneous bodies.

2. Electricity is propagated either through conduction or dielectric radiation.

3. Bodies may be divided into dielectrics and adielectrics. In the first the conductivity increases, in the second it diminishes, with an increase of temperature.

4. An electrolyte is a decomposible dielectric.

5. In every closed circuit, of which a portion is dielectric, the sum of the potential differences is either greater or less than zero.

6. The galvanic current arises at the expense of the temperature at one point of contact and produces an increase of temperature at the other.

7. The electrolytes in the circuit are always decomposed. Hence arise new differences of the potential, which may diminish the previous sum, or even reduce it to zero, through chemical polarization.

8. The change of temperature is estimated by the galvanic heating, the production of warmth at the points of contact, and the chemical heating. These changes lead to thermal polarization.

Elasticity and Electric Conductivity of Coal.

W. Becty reports a series of experiments upon some cylindrical sticks of coal prepared by Carré, estimating their modulus of elasticity by determining the note which is produced by rubbing them longitudinally with rosined fingers. All the observations showed an increase of conductivity with increase of temperature. He does not think that coal, whether compressed or prepared from gas coke, is so homogeneous as Siemens supposes, but its texture is sufficiently uniform to furnish conclusive evidence of the relations which he has pointed out.

A Cable Between Cuba and Spain.

HAVANA, April 12.—A project for laying a submarine cable between Spain and Cuba is awaiting the approval of the Minister of Public Works. The company which will own the cable has been constituted under the title of the Spanish-American (Ibero-Americano) Submarine Cable Company. It is proposed to lay the cable over a route that will be divided into three sections, the first of which will unite Portugal with the Azore Islands, a distance of 1,000 miles; the second section to extend to the Bermuda Islands, being 1,700 miles, while the third will terminate at Havana, a distance of 775 miles. The cable will be connected at the Bermudas with the city of New York by a cable of about 750 miles in length. From Havana a line about 380 miles long will be laid, connecting the cable with the Central American lines. The price fixed for messages between Spain and Havana is 30 cents a word, the present rate by the way of the United States being $1.20 per word. The company petitions the Spanish Government to guarantee the annual transmission of 1,000,000 words.

CHICAGO.—The overhead wire question is still an unsolved problem, though it is possible a compromise may be reached on cables and short poles. The Western Union Telegraph Co. has now 400 men at work taking down wires and putting up the cables, which contain 36 wires each. Several telegraph men are here watching operations, and waiting to see what will be done on the first of May. The Mayor himself doubts the practicability of the underground ordinance. Should the cable system be allowed, as now seems likely, it will take until next fall at least to finish the work, as there are about 4,000 miles of wire in the city, and it is intended to make the substitution complete even in the comparatively unsettled parts of the city. Should it not be allowed, there will be a long and expensive litigation.

A Consolidation of Electric Motor Interests, with Great Possibilities.

Negotiations with a view of consolidating the electric motor patents of Edison and Stephen D. Field have been going on for the last month, and resulted yesterday in the signing of contracts by both parties, which put an end to the fight and give the patents into the control of a new company. Three months ago, Mr. Edison was approached by the Field party and propositions were made for a consolidation. These propositions were not satisfactory, however, to Mr. Edison, and the matter fell through. About three weeks ago, however, mutual friends of both parties drew up a plan which was in general satisfactory to both. Agreements were then made out, and, after several conferences and revisions, the matter was decided yesterday. On the basis of the use of both sets of patents, a company is to be formed, with a capital of $2,000,000, for the purpose of operating electric railroads in the United States. This basis was decided upon after the value of the patents had been placed at the sum named by a committee of estimate appointed for the purpose, whose chairman was Prof. George F. Barker, of the University of Pennsylvania. The company will be organized probably during the week, and the principal stockholders will include the capitalists in this city, who have been active in bringing about the settlement. The patents, over which much litigation sprang up, relate for the greater part to the simple appliances in electric motors and other devices connected with their use. By the agreement signed yesterday, the Edison dynamo will be the generator of the electricity, but is only to be used for railroad purposes. The use of this dydamo with the devices of propulsion invented by Mr. Field will reduce the cost of running as well as simplify the mechanism of the motors, and by the union all the patents of the United States in regard to electric railroading, it is claimed by those interested in the scheme, will be in the hands of one company. There had been some talk of conferring with Siemens, of Berlin, with regard to bringing his patents into the consolidation, but upon investigation, as is asserted, it was found that his patents in this country were of comparatively little value, and he was not consulted upon the subject.

The first work of the company will be in regard to the elevated roads in this city, and experiments are to be made in a short time which, it is claimed, will result in the adoption of that form of locomotion.

Mr. Field has been given permission to make his experiments on a branch road, but in order that there should not be the slightest delay to travel, they will probably be made upon Mr. Edison's railway in Menlo Park at first.

The elevated railroad people who have examined Mr. Field's plans are firm believers in their success, and the expense in making the change from steam motors to electric will be small.

According to the present plan the dynamo machines will be run by steam-engines placed at the two ends of the road. The trains will run independent of each other, and by the simple turning of a lever it will be possible to regulate the current in such a manner as to allow two trains to approach only within a certain distance of each other, thus making the running of numerous trains in a fog perfectly safe as regards collisions.

A local or subordinate company will be formed for the purpose of introducing the electric motors on the elevated roads, while the general company will have jurisdiction over the whole United States.

The capital stock of the company is to be divided into 20,000 shares of $100 each, for which, according to the present understanding, a premium will be exacted.

It was stated yesterday that a large number of capitalists had signified their intention of taking the stock.

Mr. Edison said that the reason of his apparent readiness to sell his patents to a new company was that he had no time to take charge of the motor branch of the electric business. The electric light alone was sufficient for his company, and the business was growing so fast that it would soon be all that could be attended to. His experiments had been mostly with reference to running the electric motors on the large railroads, and he had not dabbled with horse-car roads or small affairs The experiments had been most successful at Menlo Park, and had demonstrated to his satisfaction that the motors could be used with a saving of money. This branch of the business the new company, he did not doubt, could carry on with great success. Mr. Field had experimented, he thought, on the small horse railroads, and now, with all the patents under one company, there was no reason why electric motors in a short time should not be running all over, and electric railroading be one of the great successes of the age. The motor at Menlo Park ran around the track a mile in two minutes, and much greater speed could be attained. Experiments by the new company would be continued at Menlo Park under the management of Mr. Field.

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CONTENTS.

	PAGE
An Ingenious Electric Motor	1
Some Points in Electric Lighting	1, 2
Portable Electric Testing Apparatus	3
Future of Electrical Engineering	3, 4
Electricity and Cyclones	4
Unequal Heating of Electrodes	4
Underground Communication	4
Serious Considerations Concerning Government Telegraph	5
Telephonic News	6, 7, 10
The Efficiency of Accumulators	8
An Inquiry Answered	8
Electricity in Printing Presses	8
Health at Hand	8, 9
Electric Lighting	10
Zircon for Electrical Purposes	10
Letter to the Editor	10, 11
Manufacturing Notes	11
New Electrical Patents	11
Telegraphic Items	7, 10, 11

The Efficiency of Accumulators.

We have been told by no less an authority than Prof. Edison that "the only purpose served by the storage battery is that of developing man's latent propensity for lying." Yet on every hand we see successful mechanical contrivances which could never have been without the interposition of the storage battery.

It is recorded of Alcibiades that he said the Cretans were liars, but Alcibiades was himself a Cretan; therefore, what he says is, from his own assertion, untrue. Prof. Edison says, inferentially, that those who use storage batteries are not to be believed, and as he acknowledges that he has been experimenting, and therefore using storage batteries himself, we will take him at his word and refuse to credit him in this regard—if the bull is excusable.

Seriously, to less famous electricians than Mr. Edison, the storage battery seems to be of almost inestimable value. Without the storage battery the electric railway would be open to many and serious objections, and the electric boat would be impossible; for, if it was necessary to carry a steam engine to work the dynamo, it would be as well to connect it with the shaft at once, and thus save time and expense. Aerial navigation never really looked feasible until the advent of these boxes of plates, any one of which contains sufficient power to lift itself up several miles in the air. When bicycles first came into use, much was expected of them, and the most sanguine thought they would at no distant day be in general use. But when it had been computed that the rider performed nearly as much labor in a given number of miles as he would have done had he walked, most people lost confidence in the bicycle. Emerson has said, "God gave man a pair of legs to walk with, and yet he prefers to be driven around in a carriage."

Professors Ayrton and Perry, however, are rather more of electricians than philosophers or moralists. Instead of refusing to encourage men to ride, they have taken the world as they found it, and they argue that if men will ride, it is well to supply them with an easy and economical means of doing so. Evidently with this idea in their heads, they have designed an electric tricycle by means of the storage battery. In this motor, ten little black boxes carried on the base-board contain the stored electric energy. In these accumulators, it is the receptacle which has weight, so that neither in receiving its feed in the morning nor in discharging its power during the day does the accumulator gain or lose in weight. The rider sits with the steering handle on the one side, and on the other his electric supply tap. If he wishes to go faster or up hill, he increases his supply. The little motor is fastened under the rider's seat, and drives the wheels by means of spur-gearing. With this tricycle a measured mile has been run in 8¾ minutes when carrying a man of average weight, and enough accumulators to furnish power for a run of two hours.

When in 1860 Planté produced his secondary battery, composed of lead plates peroxidized by a charging current, little more than scientific curiosity was excited. Who might not from this have foreseen the electrical railway car, the electric boat, the workshop motor, or even the electric tricycle? But it has been only since the perfection of the dynamo that the importance of this mode of storing electric energy has become of practical importance, and great credit is due to Faure, to Sellon and to Volckmar for putting this valuable addition to practical science into available forms.

A question of great interest in connection with the secondary battery has reference to its permanence, and possibly it was regarding this point that Edison spoke when he expressed himself so strong a disbeliever in the storage battery.

A fear has often been expressed that local action would soon destroy the fabric of which this battery is composed, and that the active surfaces would soon become coated with sulphate of lead, preventing further action. This, however, has been disproved by Dr. Frankland before the Royal Society, corroborated by simultaneous investigations by Dr. Gladstone and Mr. Tribe. They showed that the action of the secondary battery depended essentially upon the alternative composition and decomposition of sulphate of lead, which is therefore not an enemy but an aid to its continual action.

An Inquiry Answered.

Quite recently there have appeared in the columns of two of our daily contemporaries letters in which the writers asked for information concerning the measurement of electricity. As these letters have not been answered, and as there seems little reason to believe they will be, at least from the quarter whence answers are expected, we feel called upon to give the inquiries in question an answer in order that they may not, through the silence of those they have called upon, be led to believe that there is no known means of measuring electricity.

At present most of the proposed methods of measurement bear some analogy to the measurement of water passing through a large pipe by means of measurements taken of water passing, under similar conditions of head, &c., through a much smaller pipe. For example, suppose we have a mass of water, the head of water being constant. The water to perform work is taken through a pipe of area X, while the water actually measured in gallons or tuns passes through a parallel pipe of area $\frac{1}{1,000}\times$, or $\frac{1}{10,000}\times$. We can obtain an approximately correct idea of the quantity passing through the larger pipe in a given time. The electrical case is, however, simpler than that of the water. A definite but comparatively small portion of the total current will be taken through a branch wire and this small quantity measured just as $\frac{1}{10,000}$th part of the gas was used to actuate a measuring instrument. So long as the proportion of 1 to 10,000 was absolutely correct, so long would the user be able to tell at a glance at his register the quantity used, and we think we may safely state that the science of electricity is sufficiently advanced to enable us to give exactly the proportion of current used to actuate the register to that used in the working circuit. A definite quantity of electricity will perform a definite amount of work, and inventors like Edison knowing this fact, propose to use a certain proportion of the total current in doing such work as depositing a metal electrolytically. If a meter constructed upon this principle is placed in a house in connection with the electric light, $\frac{1}{10,000}$th, say, if the current coming to the house is used in the register the other 9,999 parts are used by the householder. The small quantity thus lost could have no appreciable effect upon the price. The proportion lost is so small that it is possibly not more than one in a million, and certainly the loss of one foot in a million of gas distributed would not affect the price of gas.

Electricity in Printing Presses.

The generation of electrictity through the friction of the belts and pulleys in the various descriptions of mills has always caused great annoyance, and has sometimes caused serious conflagration. Many persons, too, have been seriously injured by touching machinery when thus highly charged; for such electricity is static, and, therefore, of great potentiality.

In the most improved printing presses the paper, from a roll, passing rapidly over the rollers in a semi-dry condition, collects large quantities of electricity, unless the press stands upon a foundation in direct communication with the earth, which would allow of its escape.

Letters often appear in the public prints from publishers and printers asking for a remedy for this. Here is one sent to an esteemed contemporary of ours, together with the response of the editor of the journal in question, wherein he explains how the evil may be lessened to a certain extent:

To the Editor of the Scientific American:

I have considerable trouble with electricity, which gets into the paper as it passes through my cylinder printing press. If I have a small quantity of highly calendered sheets to be printed on both sides, when I run the blank sheets through there is no electricity in them; but as they pass through, the cylinder—I judge—generates the electricity and imparts it to the sheet being printed, and when the sheet comes out it is sometimes so charged that it adheres to the other sheets, causing an "off-set," and the electricity does not leave the sheets for some time, thereby interfering with the feeding of the sheet the second time through.

Several plans have been tried in this and other printing offices, such as oiling and chalking the tympan, running a copper wire underneath the paper and into a pail of water, and numerous other ways have been resorted to to remove the difficulty, but with no success. Can you suggest a plan whereby the electricity can entirely be removed?

Chicago.

[ANSWER.—The same difficulty that our correspondent speaks of is experienced in many other printing offices. In a dry atmosphere, in buildings where the floors are insulated by dry timbers, electricity will be abundantly generated when non-conductors such as belts or sheets of paper are put in motion. The most effective remedy is to produce a damp atmosphere in the room or shop.

This may be done by thoroughly wetting the floor with water. In the printing rooms of the *Scientific American* it is found that sponges saturated with water and placed on the fly-table serve a good purpose; and our printer has proposed to use pans of water having perforated covers for the same purpose. In damp weather the electricity does not make its appearance.]

It may seem like presumption on our part to prescribe a remedy for an ailment that in this case has been placed under the treatment of our contemporary. But the fact that electricity is a specialty with us and that there are many other sufferers besides the correspondent in question, would seem to be a sufficient excuse for such a course.

A more effective remedy for the evil complained of than is contained in the response of our contemporary will be found, we think, in bringing down from the ceiling to within a few inches of the belting an iron rod that has been attached to the gas or water pipes by a wire. At the lower end of the rod a brass bar should be fastened to which should be attached a number of brass knobs, each an inch apart, and brought up to a point almost in contact with the belting. As fast as the electricity is formed it will pass through these knobs and thus through the iron rod, wire and water pipes harmlessly to the ground. What little is not thus drawn off will, after passing through the machinery be taken off by a wire that should be made to connect the machine and a neighboring gas-pipe.

By means of these two ground wires we think the inquiring correspondent will find that all the electricity of which he complains may be got rid of.

Health at Hand.

EVERY HOUSEHOLD ITS OWN DISPENSARY, AND EVERY MEMBER HIS OWN PHYSICIAN.

BY DR. O. K. CHAMBERLIN.

When the celebrated De Quincy first took to opium-eating, he says that he congratulated himself that happiness could be bought by the gallon, and unlimited draughts of enjoyment corked and uncorked at will. The degree of pleasure he experienced from the practice was so great that he viewed every grain of opium and every drop of laudanum as an epitome of so much delight. He had only to swallow them to be transported to

the regions of ecstacy. They put wings to his shoulders, so to speak, and enabled him to fly above mankind and look down with good-natured scorn upon their inferior sources of entertainment. He carried enchantment in his pocket in the form of a laudanum-filled vial, and measured glee and gladness at the rate of so many drops per day.

We now venture to propose a plan which, startling as it may seem, will provide the public with truer and profounder sources of satisfaction than any which poor De Quincy enjoyed, and without the accompanying penalties which he afterwards paid. Picture to yourself, reader, health, strength and vigor to be ready waiting your touch. Imagine your house supplied with them, or, what is the same thing, with the means of procuring them, in the same way that it is now provided with gas and water. Conceive, if you are able, such a state of things as that, by pressing a knob, or turning a screw, a certain medium would be set in motion that would carry health to men and women just as surely as water carries cleanliness to the person and gaslight to the eyes.

An impossible state of things, you say!

The nineteenth century has done much in the way of invention, but it has not done anything of so wildly improbable a nature as this. It has linked hemispheres by a thread of wire and oceans by a rail of iron, and these achievements seem to be the utmost reach that it is capable of. It has made various ventures in the field both of physics and morals, but it has never pretended to anything so magical as the bringing of health and happiness to households, and making them as accessible as gas and water.

So you, the reader of these lines, are probably thinking or exclaiming in answer to the foregoing remarks. We claim attention for a few moments until we have briefly explained our theory. For thirty years we have been working hard to convince the public that there is one cure for all diseases which renders other remedial measures vain and defies the popular prejudices of the day. That cure is *electricity*. We have toiled very long and very patiently in the endeavor to prove to the great public—too often hampered by the shackles of bigotry—that the draughts they have been swallowing are more than useless, and that the same beneficent medium which flushed the storm cloud with its angry glory and palpitates like a golden blush along the shadows of a summer sky is, after all, the only reliable healer, as it certainly is the gentlest and most pleasant.

What we now propose to do, as a means of making health an inhabitant of every household, is to encompass New York City with a metallic network of wires communicating with every residence; to construct stationary electro-batteries of sufficient power to supply every house with various qualities of electricity, and by subaqueous and atmospheric lines to Brooklyn, the suburbs, and so on, until in the development of time there shall absolutely be no limits to its application.

This, then, is the idea which we have long cherished, and which we now give shape for the first time. That it will be derided and turned into ridicule; that it will awaken the spleen and antagonism of the medical fraternity generally; that it will become the occasion of much personal abuse and contumely, we know but too well; but that it will also do good, that it will gradually steal its way into favor through the hearts and minds of the intelligent and liberal, and that it will finally become adopted as universally as gas and water, we have not the shadow of a doubt.

Let the reader, then, turn this thought over in his mind until he realizes what it means throughout its entire depth, width and length. It means health and happiness, not for one creature here and there more fortunate than his fellows, but for the entire people of New York, and in process of time, according to the laws of gradual growth, for the entire world. Its design is as beneficent and charitable for the bodies of men as Christianity is for their souls. In fact, electricity, when properly administered, may be called the Christianity of the body.

Electrical Notes.

We are glad to see that electricity is to play an important part at the coronation of the Czar. For four nights the great belfry tower of iron at Moscow was splendidly illuminated by electricity. No fewer than four thousand incandescent lights cover the cupola, and 120 electric lamps of Russian invention outline the cross. All the principal churches are to be illuminated with ordinary lights from foundation to spire.

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The Czar has, it would appear, lost confidence in foreigners, for he has refused to employ any English illuminating or pyrotechnic firms on this occasion, though many such were given employment upon the occasion of the coronation of Alexander II.

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We took occasion recently in these columns to comment on the fruitless toil and trouble some people give themselves by working at ideas which, had they but inquired, they would have learned had been worked out years before. We might have included those people who work and worry and waste their money on various problems, without even informing themselves of the natural laws thereof.

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A machinist came into our office the other day, carrying under his arm a home-made specimen of an underground conduit for electric wires, which he informed us he had invented, and for which he had obtained a patent. He had called to interest us, if possible, in his invention.

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We examined it carefully, and finally told him that, while we had no doubt, if properly constructed, it would make a good insulator, we feared that, as its principal insulating material had a high inductive capacity, trouble would arise therefrom. We casually informed him that there were already some 300 wire conduits in the market, but none of them had, thus far, successfully overcome induction, which, we added, is now the great desideratum in an underground wire conduit. "What," asked he, "is induction?"

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Our humorous friend tells the story that when he built his house in Connecticut he found the only way to get rid of the lightning-rod agents was to permit each of them to attach their rods to his house. When thunder storms arose, however, he found all the lightning in the vicinity was attracted to his house, and the inmates thereof were compelled under such conditions of the atmosphere to fly to the neighboring dwellings for safety. He acknowledges, however, that all the rods were in good order, and that the danger was rather apparent than real.

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That was some time ago, and, if we may rely upon some recent reports of tests applied to lightning-rods, many are really very defective, and are more liable to conduct the vagrant electricity into the house than into the ground.

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Again, many have lost efficiency by accumulated rust, especially is this the case with old structures.

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A test was recently made of the efficiency of the lightning conductor upon the General Assembly Hall in Edinburgh by means of a copper wire attached to the upper end. The conductor, which is a ¾" copper rod, was put up some twenty-nine years ago. When a current was sent through it by means of the copper-test wire its resistance was found to be as much as 800 ohms. This was, of course, sufficient to condemn it, and arrangements were immediately made to set up a new copper-wire rope conductor ½" in diameter which, after reaching the ground was soldered to a water main. When this was completed the resistance of the metallic circuit, consisting of the test-wire and the new lightning conductor was discovered to be somewhat less than $\frac{1}{10}$ of an ohm, and when the earth connection was included in the circuit, the resistance did not exceed 1 ohm.

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The Post-Office authorities have for years been searching for means of so cancelling postage stamps affixed to letters as to thwart all attempts made by the unscrupulous to use them again. All kinds of ink have been used, but nevertheless, certain products of the laboratory have been found to obliterate its marks.

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The current number of *Le Courier des Brevets D'Invention* contains, in this regard, a description of an electric apparatus, which, no doubt, will prove of great interest to the postal people. It was invented by M. J. Châtenet, and is of such ingenious construction as to burn, by the aid of electricity, three parallel lines through a postage stamp without in anywise injuring that portion of an envelope which lies immediately underneath.

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The French scientific journals are loud in their praises of an improvement recently made in the Bell telephone by M. d'Arsonval, the well-known telephonist. For its size and weight, the new receiver is said to be the most powerful yet constructed. The chief modification consists in inclosing the bobbin entirely between the poles of the magnet. This is accomplished by making one pole of the magnet the core of the bobbin, and the other pole an enclosing ring of iron. The inductive plate vibrates over the poles and upper surfaces of the coil as before. The complete instrument is said to weigh a little over five ounces, and is stated to be as powerful as the heavy Gower-Bell receiver. Magnets of steel tempered by compression, after the manner introduced by M. Clemandat, and, since this mode of tempering does not deform the magnets, a neater instrument is the result.

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It is a singular fact that practical men are continually distancing the learned theorists who toil all day in their laboratories.

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Trouble has always been experienced in cotton and woolen mills by reason of the generation of electricity by the friction of the belts in the pulleys. This electricity being carried into the spinning-machine effects the cotton, especially if it is in a loose condition, before it is warped and causes it to fly apart and stick to all portions of the machinery, thus causing great trouble.

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A means of remedying this was recently discovered by Mr. F. W. Whiting, a clerk in the Boston Manufacturers' Mutual Insurance Company. He found that the principal belt in the Armory Mill in Manchester, N. H., where he first began his experiments, made 400 revolutions per minute, and generated so much electricity that when the oiler attempted to oil the machinery he was almost paralyzed.

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Strange as it may seem, it only required the application of a very simple principle of electricity to rectify the evil. The earth is the great reservoir of electricity, and wherever there are proper conductors the current finds its way by the shortest route to the ground.

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Going to the carding room, the young man attached a wire to one of the carding machines and carried the other end to the gas pipe where he fastened it. The trouble ceased at once, and doubtless everybody present wondered why he had not thought of it before.

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Mr. G. W. Blanchard for a number of years in the superintendent's office of the Western Union Telegraph Company, New York, has resigned to accept the position of manager in the telephone department of Messrs. Delano, Haines & Co.

These are the days for theories. Many of the old ones that were perforce received for want of better are being gradually discarded.

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There were always weak places in them that could not be strengthened or cut out, owing to the lack of the right kind of material in the hook on which they were hung.

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This, however, seems to be all changed now, or at least rapidly undergoing that change, since the hook has been formed out of electricity.

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Natural phenomena of all kinds are now attributed to it, storms of wind and rain, the motions of the planets, thunder and lighting—and it is also very plausibly shown, and in fact logically proved that the sun is not a burning mass at all, but might be very truly likened to a dynamo machine producing light and heat, though having neither of those qualities within itself.

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It is only a question of time, no doubt, and not a very long time at that either, when navigation through the air will be an accomplished fact.

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By this means also the pole may be discovered at last, and such certainly would be the most natural and desirable manner of reaching that result.

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It might be well, indeed, for those who have spent so much time and money (in addition to the great sacrifice of human life) in this heretofore futile and fatal attempt to turn their attention to this new power in furtherance of that perilous undertaking.

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The telephone has one great advantage over the telegraph.

When one man is sure he sent the message as written, and it is almost as plain as print, and the other man is quite as certain that he got it just as it came, and yet both sides do not tally, of course the wire or the instruments are to blame, and unfortunately they do not have a chance to defend themselves, owing to the lapse of time and other circumstances. When the telephone, however, undertakes to play any tricks of that kind it is promptly pulled up with a short turn, and it has to explain itself fully then and there if the word or words have to be spelled out letter by letter, and several times to boot. There is no refund asked, and the amount of damage is seldom more than a ruffled temper.

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Why could not those of our legislators who absent themselves from their duties, under the pairing-off system, turn an honest dollar in another direction at the same time by offering their services as units of current strength to the electrical companies? Each one of them might present himself as an "ampere-d." Don't perceive? Patent applied for, for this joke.

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Would it not be a move in the right direction for the N. Y. Electrical Society to inaugurate a school of mathematics, as a means towards the successful accomplishment of the results sought to be obtained by its establishment?

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This would seem to be peculiarly its work. It might be carried on either through the aid of some of the members who are properly qualified, and there must certainly be many who are, or a teacher could be procured at a small outlay for each of those who attended.

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Such a course would impart knowledge, the lack of which at present makes the study of this subject exceedingly difficult, if not almost impossible, to a large number of those whose interest lies in this direction.

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If some such step as this is not taken, the colleges will see to it that the plodders in the new field of engineering will still be the

plodders of the past, and that the guides and leaders of the new movement will be those whom they are preparing for that work. What is the opinion of those most concerned in this matter?

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Now is the time for energetic steps and progressive action.

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The following story reaches us from Arizona Territory: In that vicinity the Spanish word "buro," for that patient animal, the jackass, is in common use. A station agent in that territory having occasion to ship a jackass to one of the Eastern States, billed it as a buro. Some days later he received a telegram from the eastern station agent, reading: "I am short one bureau and over one jackass. What shall I do with the jackass?" To which the Arizona agent replied: "The buro and the jackass are both drawers. Get off him and you will see it. Deliver the jackass to the buro's consignee."

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We are informed that during a recent visit of Ex-President Diaz, of Mexico, to the Western Union building, in this city, he sent a message to the Associated Press agent in London, to which he received an answer in twenty minutes. As this includes the time necessary to deliver the message from the cable office to the Associated Press office, and the time taken to write the answer, quite a lengthy one, the actual time was probably about nine minutes. A subsequent message was sent to the manager of the London cable office, which elicited an answer in six minutes fifty-eight seconds.

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This must have somewhat astonished the worthy Ex-President, who, if he were to receive an answer from the capitol of his country within six hours, would probably feel that a great deal had been accomplished.

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And we all must admit that the excellent time made in the handling of the above messages shows a high state of efficiency in the cable service.

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The installation of 200 Edison lamps in the offices of the New York *Sun* is a notable victory for the Edison company, as one of the principal owners of that journal is a heavy holder of gas stocks, and it has been the chief opponent of Edison's system. It has had an article this very month insisting that electric lighting was a failure.

A special meeting of the stockholders of the Mutual Union Telegraph Company has been called to be held May 5, to vote upon a proposition to reduce the capital stock of the company from $10,000,000 to $2,500,000. Under the lease to the Western Union, the company is guaranteed a dividend of 1½ per cent. per annum on its stock, and the object of the reduction of capital is to make the stock a full 6 per cent. stock.

Zircon for Electric Light Purposes.

Among the minerals of the country which promises to be of material industrial importance is zircon—a substance rare in quantity elsewhere than in Henderson County, in the western part of North Carolina—formerly a part of the famous Buncombe County. Nearly two-thirds of this mineral, or 65.30, is zirconia, with 33.70 silver. Zirconia, among the most infusible of substances, is also a non-conductor of electricity, a quality which General Clingman, of North Carolina, has utilized by the invention already patented by him, both at home and abroad, of a combination of zircon with carbon and other elements for electric light purposes. Experiments made at the Smithsonian Institute establish the fact that such a combination will produce a brilliant electric light without the least necessity for excluding the air, as in the Edison and other inventions The electrician of that institution, Mr. I. Green, has stated under oath that the pencil thus made underwent no change from the heat, and that it appeared that such a light might be kept indefinitely with a single pencil.

Inasmuch as the carbons in use in the arc lights are consumed at the rate of from ten to fifteen inches in a single night, and also require a clock-work to keep them adjusted, General Clingman is of the belief that the use of zircon for electric light purposes will be far superior to that of any other substance as yet discovered. We may add that the name zircon was originally given to this mineral because it was regarded as worthless; consequently, should it prove to be as valuable for electric light purposes as would now seem probable, we should have another noteworthy illustration that Nature makes no worthless thing.

Electric Lighting and Some Inherent Difficulties.

By A. E. Conti.

I beg that you will permit me to occupy by this letter a space in your leading Review, with the view of exposing to your readers a few difficulties which still exist (in spite of the great efforts made by some to overcome them) in connection with electric lighting supply and measurement on an extensive scale.

We have of late grown so accustomed to the numerous lectures and notes on electric light, that, in reality, it would seem rather an unnecessary, if not a vain attempt, on my part, to draw again the attention of those who have taken great interest in a subject on which too much has already been said, were it not for the sole motive to make clear that some difficulties exist at present of the same magnitude as existed some time back, in spite of the great progress hitherto made, and by the assurance given by some electrical "eminences" that the arduous problem no longer remains to be solved.

In any system, whether parallel or series, arc or incandescent, constancy is the characteristic point to be aimed at, and this is not easily attained when the consumption or demand varies rapidly.

The necessary variable electromotive force obtained for the above purpose, whether obtained by a variable speed of the armature, or by varying the strength of the stationary magnets, or by shunting the whole or part of the generator, by means of resistances or accumulators, must be such to vary with prompitude, so as to maintain throughout the system a perfect equilibrium, when hundreds, and perhaps thousands, of lamps may be put on or off without disturbing the remainder.

In a parallel system, for instance, this variation is that which necessitates for maintaining a constant difference of potential between the mains with a variable current; inversely, in a series system, it has for its mission, to maintain a constant current with a variable difference of potential between the main conductors.

Comparing electricity with gas supply, it is obvious that the difficulties arising out of inconstancy of supply are not to be easily met with the same method in use with gas.

Electricity has no storage throughout the system, and if a number of extra lamps are to be fed, the extra supply must come from the generator, and this must be ready, otherwise these extra lamps will extort from the others (as far as light is concerned) more than they actually will produce.

As electricity cannot be supplied like gas, it cannot be measured as such, inasmuch that electricity cannot be regarded as anything but the ethereal matter (if the theory is accepted) in motion, which never varies in quantity in a given circuit or conductor, so long as the electromotive force is generated within.

The increase and decrease of the electromotive force only vary the velocity of this constant volume of ethereal matter moving in the circuit, and since the velocity can be regarded as constant when the electromotive force and resistance varies with the same ratio, it follows, as a natural consequence, that to measure the rate of the actual work done in a conductor, not only is it necessary to know the velocity of the matter in motion, but the motive force which produced that velocity, since the other quantity (the resistance) can modify it.

If the motive force cannot be measured, the resistance will be sufficient when multiplied into the square of the velocity for finding the rate of the work done in the circuit, better known as electrical energy.

Contrary to electricity, gas is a rarefied combustible, which only necessitates the measurement of its volume at the normal pressure to find a correct measurement of the light produced.

The pressure put on at the gas factory is only equivalent to a mechanical work done for sending the rarefied combustible to the burners and force it out at the same rate as the chemical action of combustion of the flame can dispose of, and in no way contributes to the intensity of light (when the normal rate is reached) except by forcing out a surplus quantity of gas which goes to waste in the air, thus making the flame less economical. Whilst by turning the gas-tap a considerable amount of extra pressure can be regulated, thus effecting economy, the same method cannot be applied to electric pressure except by introducing a resistance, which means nothing else but waste of electric energy in producing caloric externally.

It becomes evident that the two chief difficulties yet to be surmounted for making the electric light supply a complete success are, first, to vary promptly the supply according to the demand; and, second, to measure the electric energy in an exact equivalent of the light produced.

The problem for economically supplying electricity to meet readily a variable demand is an arduous one, and is one which has much engaged the minds of many physicists and electricians, but unfortunately I must say with little reward of success.

Many propositions have been made and tried, but none of them have succeeded in effecting the "desideratum," consequently all of them fell in the same ditch. Recently Professors Ayrton and Perry have proposed (which are said to have been tried) eight different ways of connecting up to generators for obtaining either constant current (with a variable demand) or constant difference of potential between the mains, but unfortunately, in my opinion, these, like some previous ones, possess the same fault in degree, namely, that of disregarding economy.

Indeed, it seems to have entered the mind of these two physicists that for obtaining the above "desideratum," economy to a certain extent must not be absolutely regarded as one of the characteristic points to be aimed at.

Two faults appear to me very conspicuous in these systems of connecting up, namely, first to send the whole or part of the current through each other's armatures, which means nothing but loss of electric energy in heating the armatures, not to say (see Lenz law) the great drawback in not allowing the generators to develop the maximum electric energy in proportion to their weight and construction; and, second, the shunting in some instances of the two generators, which means only inefficiency when the external work falls to a low figure, and the armatures are still kept running at the same speeds by means of the so-called good loaded regulators.

Attempts nave been made to utilize the accumulators to effect this end, namely by storing up the (if storing is correct) electrical energy when the demand falls under the constant production, and giving it out when the demand rises above that production; but even here the results from experiment made greatly disappointed the expectations. So it will be as long as the accumulators remain in the present state of perfection—different from the general belief entertained by many when they were first announced by a letter in the *Times*, from a great physicist, that boxes containing a million foot pounds of stored-up electric energy were received in Glasgow from Paris—though, even as they are, there is a large field to utilize them for other purposes than the above.

Supposing by some means or other the difficulty of supply was overcome, the next would be, how to measure and record a true equivalent of the light produced? This is not so easy to answer as it would appear at first sight.

It has been shown that the candle-power produced in an electric lamp (say, incandescent) is not proportional to the strength of the current passing through it, consequently a meter that measures and records the sum of the strength of the electric currents cannot measure an equivalent of the light produced; hence other means must be resorted to.

It has been said and shown, I believe, that the light produced in a lamp is proportional to the product of the current and pressure, or electric energy as it is sometimes called.

Although this product is a good step towards the real value (and I believe that there is a short range which is proportional), it cannot be accepted, for a long range, as the correct measurement of the light obtained unless it should be connected with that function, I believe, yet undetermined, consequently a meter which measures such a compound for a long range cannot give a true equivalent of the light produced.

Energy-meters, or erg-meters as they are called, would be quite what is required if the electrical supply was only used for mechanical and other purpose other than light.

Suppose in a parallel system a constant difference of potential was maintained between the mains, and all the lamps constructed to give their maximum efficiency for light with the same difference of potential (leaving only a small margin for an accidental increase of difference of potential, to prevent destruction of the filaments), of what use would an "erg-meter" be in this case? A clock-recording current meter would be sufficient for all the necessary measurement, with the advantage over the former of not having a leakage, and an installation with hundreds or thousands of meters would hardly satisfy the supplies to have a leakage at every meter.

In conclusion, electric light supply, far from being perfected, has still to struggle for it, and "shareholders in connection with its financial stage must be patient and wait for their promised land."

If installations are made to light a constant number of lamps, such as the street lamps, the supply would escape from the above difficulties, and where motive power is available at a little cost they can be greatly disregarded.—*London Electrical Review.*

To the Editor of the Electrical Review:

Sir,—As three is the magic number in electricity, whether of metals or of chemicals, I would suggest as an experiment for a better effect that sulphuric acid, oxalic acid and alcohol be used in connection—the non-acid, the acid and the acrid, alcohol being the electrolyte.

Three liquids that are unlike may make a circuit equally as three metals or chemicals. We have found that a two-liquid battery is better than a one. The effect of powder is caused by three ingredients that are entirely unlike, and hence not affinity, but disturbance. The most unlike, the greater the affinity, or rather the disturbance, is the law. As lightning is caused by disturbance, so is electricity the effect of disturbance. In the electrolysis of water it is the action on the plates of the acid in the water that is disturbed by the copper at one pole and the zinc at the other that causes the hydrogen and oxygen of the water to separate. *If water were a conductor, this effect could not be produced.* The fact that a wire conducts through water does not prove that water is a conductor. Water cannot be charged with electricity to the extent of an atom. It is the most effective destroyer of electricity. The Review referred last winter to the phenomenon of "frictional electricity," by which some eastern printers had been annoyed. This can occur only in extremely cold weather, when the paper has been brought from a cold room and placed in con-

tact with a warm cylinder. It can be avoided by keeping the paper in a warm atmosphere.

It is the effect of the warm dry and the cold dry in contact, just as the contact of warm dry and cold dry air produces the aurora borealis and the lightning. What makes lightning destructive is that it must travel through water—not that it conducts the lightning, but kills it. The lightning, in escaping from it, is seeking a dry object.

GEO. LECRONIER.

April 27, 1883.

Notice.

TO THE STOCKHOLDERS OF THE MUTUAL DISTRICT MESSENGER CO., OF BOSTON.

Under the provisions of the by-laws, a special meeting of the stockholders of the Mutual District Messenger Company, of Boston, is hereby called for May 3d, 1883, at Room 28, No. 47 Devonshire street, Boston, at 12 o'clock noon, for the purpose of voting on the proposed increase of the capital stock of the company to $250,000, and for the purpose of voting upon the ratification and approval of the certain agreement made and executed on the 19th day of April, 1883, by and between this company and the District Telegraph Company, of Boston, or such modified agreement as the stockholders may approve, providing for the purchase by this company of the property, lines, privileges, and business of the District Telegraph Company, and for the further purpose of amending the by-laws of this company and doing such other acts as shall be necessary to perfect the agreement referred to above.

By order of the Directors.

ALLEN S. WEEKS, Secretary.

Boston, April 23, 1883.

NEW PATENTS—ELECTRICAL—1883.

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING APRIL 3, 1883.

275,005-6 Automatic signaling apparatus; Frank B. Wood, New York.

275,169 Armature for dynamo-electric machines; Edgar A. Edwards, Cincinnati, O.

275,296 Automatic signaling apparatus for telephone circuits; Theodore N. Vail, Boston, Mass.

275,339 Automatic printing telegraph; Alfred F. Johnson and Frank B. Johnson, Brooklyn, N. Y.

275,334 Duplex telegraph; Joseph E. Fenn, Elizabeth, N. J.

275,180 Electric conductor for railway track circuits; Stephen D. Field, New York.

275,182-3 Electric arc lamp; Joseph R. Finney, Pittsburgh, Pa.

274,916 Electric arc lamp; J. Allan Dalzell, New York.

274,997 Electric arc lamp; Silvanus F. Van Choate, New York.

274,999 Electric arc lamp; F. G. Waterhouse, Sacramento, Cal.

275,168, 275,170-1-2-3-4 Electric arc lamp; Edgar A. Edwards, Cincinnati, O. (six patents.)

274,959 Electric lamp globe; George J. Murdock, Binghamton, N. Y.

275,179 Electric elevator; Stephen D. Field, New York.

275,237 Magneto-electric machine: Siegfried Marcus, Vienna, Austria-Hungary.

275,185 Polarized relay for quadruplex telegraphs; George W. Gardanier, Brooklyn, N. Y.

274,899 Pole for galvanic batteries; Burton F. Blackall and John C. Decker, Rochester, N. Y.

275,181 Receiving instruments for quadruplex telegraphy; Stephen D Field, New York.

275,195 Supporting and preserving telegraphic conductors; James H. Green, Brooklyn, N. Y.

275,289-90 Safety self-closing shunt switch for electric light circuits; Elihu Thomson, New Briton, Conn

274,905 Secondary battery element; Charles F. Brush, Cleveland, O.

275,178 Speaking telephone; Stephen D. Field, New York.

275,310 Telephone transmitter; Edward L. Wilson, Boston, Mass.

275,233 Underground conduit; John Lynch, Washington, D. C.

275,023 Underground conduit for electric wires; Henry Clay, Philadelphia, Pa.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

Plan for Underground Wires.

MR. WILLIAM MACKINTOSH EXPLAINING A SCHEME PROPOSED BY HIM.

Mr. Wm. Mackintosh, of Providence, R. I., has a system of underground telegraph lines of which he is the inventor.

Mr. Mackintosh was for sixteen years Superintendent of Construction in this city for the Western Union Telegraph Company, and has had thirty-eight years' experience in the building of telegraph lines.

In 1874, while still in the employ of the Western Union Company, he patented the system of which he is the inventor. Additional patents were granted him on improvements, until now the system is covered by five.

The system as described in the letters patent consists of a "combination of a series of working chambers, a series of conduits connecting said working chambers and opening laterally into them, and of a series of sectional cables composed of groups of insulated wires loosely inclosed within said conduits when said cables are constructed in independent sections equal in length to the distance between said working chambers in which the adjacent ends of said cables are united to form a continuous series and to facilitate removal, replacement or repairs."

Mr. Mackintosh's plan is to inclose a number of cables, each containing as many wires as may be wished, in a block of artificial stone 12½" square, extending from chamber to chamber under the sidewalk. This stone is to be molded in sections, with thirteen or more holes or conduits running longitudinally through the sections.

Each electrical company is to inclose its wires in a cable, and the cable is to be run through these conduits in the stone. The wires on all the streets are to be gathered into these cables and run through the stone conduit, which is to be laid about three feet under the sidewalk. Two blocks apart, upon the line of the conduit, are to be built under the sidewalk at the intersection of the street a vault about five feet square, to be entered from a manhole in the sidewalk. These Mr. Mackintosh calls "working chambers."

Connections between the links of the cables extending from chamber to chamber are here made, cables disconnected and drawn out for repairs, new ones put in and loop lines to run around blocks connected

Each electrical company will own its own cable and make its own repairs or alterations.

When the conduit is laid ex ra holes or passages will be provided for new companies who may wish to use the system in the future.

The conduit blocks are to be made of a combination of sand, broken stone, cement and certain chemicals. This artificial stone is said to be as hard as granite.

Should the pipe become broken by an explosion or by any other accident it can be repaired without interfering with the cables by inclosing them in shields and surrounding them with the plastic stone. Provision is made for tapping the wires to run lines into buildings by leaving, when the pipe is laid, sections which can easily be removed. The plan is to run lines into buildings as gas and water is now taken in.

"By connecting a series of loops," said Mr. Mackintosh, "a wire can be put in any number of houses in a city or in any part of the city, or all houses can be placed on the same wire. The work can be done without opening the streets after the system is once down. One thousand or one thousand two hundred wires can be placed in a conduit block one foot square."

The system has been brought to the attention of the electrical companies in this city, which are now discussing methods for running their wires under ground.

Electrical Review.

We have frequent inquiries for something which will keep up with the procession on electrical matters. If any of our readers want a first-rate thing let them write for a copy of the ELECTRICAL REVIEW, 23 Park Row, or Post-office Box 3329, New York City. N. Y.—*Cotton, Wool and Iron.*

Manufacturing News.

New Machine Shops, Foundries, Hotels and Mills.

It is said, on good authority, that the Gilliland Electric Works of Indianapolis will move to Chicago September 1. The factory gives employment to 150 men, and turns out 100 complete telephones a day. In Chicago they will occupy a six-story building which is to be constructed especially for them on the corner of Clinton and Van Buren streets.

The Western Fence Company of Chicago has taken a contract to furnish 360 miles of wire fence for the Toledo, Texas and Rio Grande Road. The fence will follow the track-laying, and is to be finished before regular trains are put on the road.

The Lawson Cash Carrier Company of Lowell will erect a four-story brick building 50x150 feet.

The city of Boston has appropriated $83,000 for electric lighting this year. This is the largest appropriation ever made in any city in this country for that purpose. The Brush Electric Light Company, of Boston, expects to get most of this lighting.

The Swift Creek Cotton Manufacturing Company of Virginia has been organized in Petersburg, Va. R. T. Arrington is the President. The capital stock is $100,000, $70,000 of which has already been paid in. The mills of the company in Chesterfield County, near Petersburg, are the finest in the State.

The West Shore Railroad contractors are using the electric light for night work in the vicinity of Newark, Wayne County, N. Y. As soon as the ground is soft enough to admit of plowing and scraping, the electric light will be used through Monroe County.

The imports of copper into England in 1882 were 96,222 tons; exports from England, 55,684 tons; British production, 2,599 tons; English home consumption, 44,820 tons; imports of all kinds into France, 13,573 tons; English copper into France, 7,022 tons; French consumption of copper, imported, 15,506 tons; French consumption of English copper and copper imported, 21,528 tons; English consumption and French consumption of copper imported from England, 66,340 tons; English consumption, English exports, and French consumption of copper imported, 115,010 tons.

The Westinghouse Engine Company are successfully using their new automatic cut-off in their larger engines. This improvement has many advantages for electric light purposes. Among them the economy in fuel is a direct step toward practicable and profitable lighting by electricity. This company have recently furnished motors for three large plants—a 110-horse power engine for the Pennsylvania Electric Light Company at Harrisburg, Pa.; another, 43-horse power, for the Brush Electric Light, Savannah, Ga.; another, 43-horse-power, for the New York and Brooklyn Company; besides several smaller engines, ranging from 4 to 18-horse power, for various local companies.

The Armington & Sims Engine Works, Providence, R. I., have within the last week received orders for twelve engines, 14½" diameter by 13" stroke, for the village plant or system of lighting with the Edison incandescent light. Also for ten engines, 8½" diameter, 10" stroke, for smaller capacity of plant for a village isolated light; one engine, 9½" diameter, 12" stroke, for Ford's Opera House, Baltimore, Md.; one 8½x10" engine for a Long Branch hotel; one 8½x10" engine for St. Louis, Mo. All the above engines are ordered to be run in connection with the Edison incandescent system of lighting.

The March yield of copper at Lake Superior copper mines was 2,661 tons of ore and 6,288 pounds of copper as against 2,536 tons and 3,601 pounds in 1882.

The Westinghouse Steam Engine Company of Pittsburg and New York, together with the Westinghouse Air Brake and the Union Switch and Signal Companies, have taken the largest space at the Chicago Railway Exposition. The exhibit will include the first Westinghouse engine made by them. A class of engines will be shown with cylinders ranging in size from 4" to 14". They will also light a portion of the building with a Brush dynamo, driven by a 7x5-inch engine at the rate of 800 revolutions per minute.

A new cotton factory was started at Sheboygan, Wis., last week. The factory is owned by the Beaver Dam Cotton Company, has cost $250,000, and is a perfect institution throughout, full of modern machinery. It contains 300 looms, which turn out a fine web of sheeting, samples of which to preserve as mementoes were eagerly sought by the people present to witness the event.

Business Notices.

The attention of persons interested in local telegraph and telephone organizations is respectfully called to the electric lighting system of The Fuller Electrical Company, and the practicability of making arrangements with that company for the introduction of its apparatus, either in isolated plants, or through the formation of local companies desiring to engage in the business of electric lighting. The specially valuable feature of this company's system may be seen by examination of its apparatus in Boston, Worcester, Providence, Hartford, New York City, Brooklyn, Jersey City, Paterson, Philadelphia, Lancaster, Scranton, Syracuse, Rochester, Buffalo, Pittsburgh, Wheeling, Steubenville, Xenia, Dayton, Grand Rapids, Chicago, Springfield, Belleville, St. Louis, St. Paul, and many other smaller places throughout the country. Correspondence is invited.

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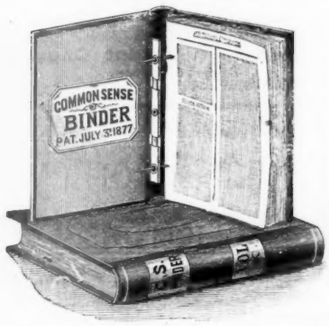

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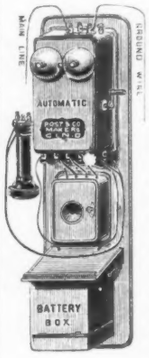

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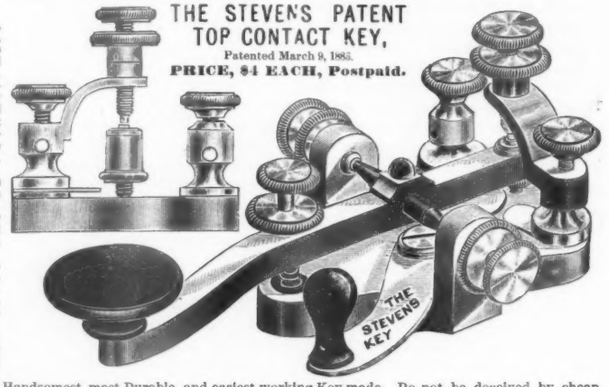

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The Commission of the International Electric Exhibition at Vienna, 1883, gives due notice to the public that this Exhibition is to take place in the course of this year, to be opened on the **1st August,** and to be closed on the **31st October,** and cordially invite Exhibitors and Visitors. The Regulations and the blanks necessary for Applications are to be had at the **Austrian-Hungarian Consuls.** The objects to be exposed will comprise all Machinery, Apparatuses and Implements connected with Electrotechnic It will certainly afford a good opportunity to inventors to show their latest improvements. This Exhibition is greatly favored by the Austrian Government, and will be held in the Rotunda of the well-remembered Universal Exhibition of 1873. Exhibitors are requested to procure the necessary papers at once.

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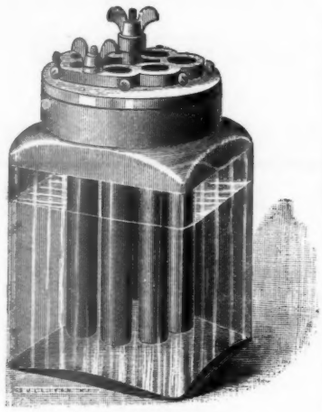

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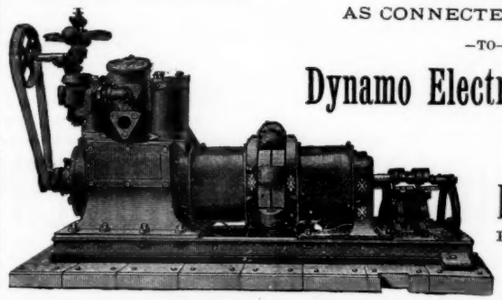

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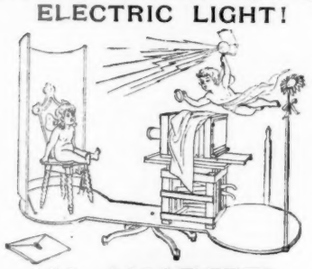

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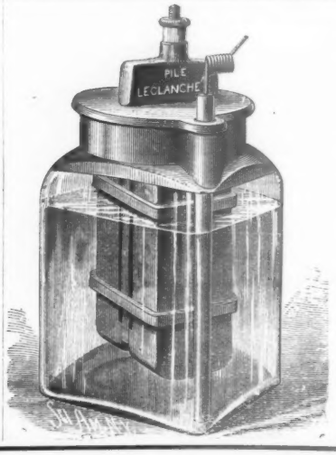

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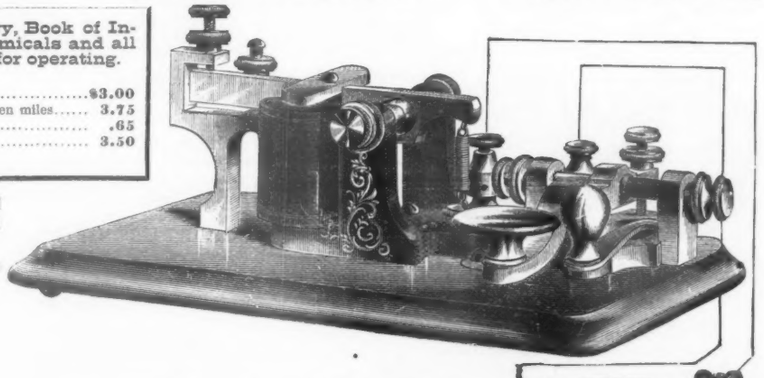

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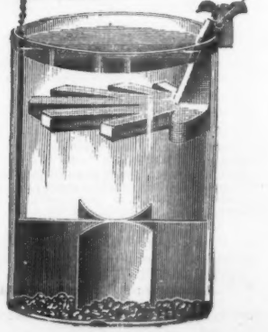

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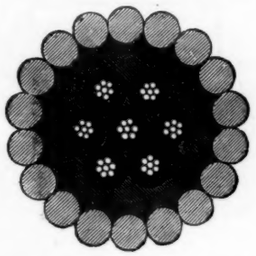

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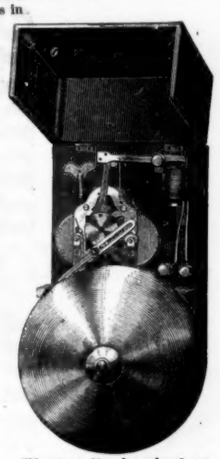

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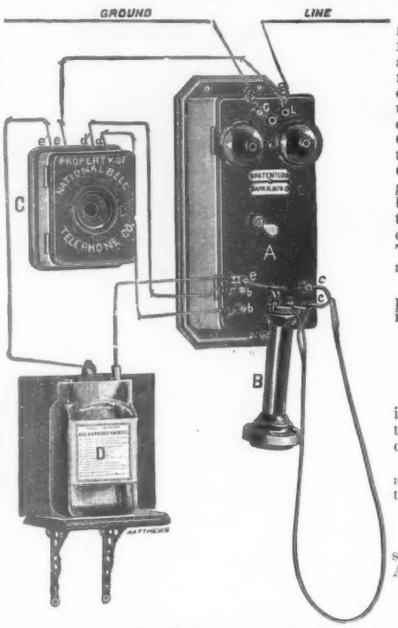

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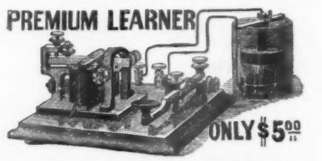

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